THE GLASS INDUSTRY

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FROM COTTON FIELD TO BOTTLE PLANT IN 95 DAYS

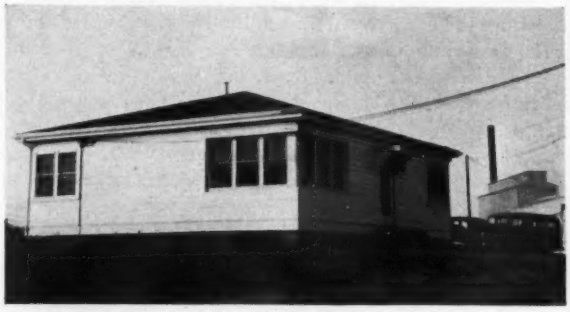
Knox Glass Bottle Company's new factory in Palestine, Texas, was producing ware 95 days after the ground was broken. Use of arched truss construction greatly facilitated the construction of this modern up-to-date container plant.

On a plot of ground that at this time last year was a cotton field, now stands a modern Knox Glass Bottle Company factory. Just ninety-five days from the time the contract for the construction of the plant was signed, bottles were coming through the lehrs. For the type of building erected, a new speed record in construction time is claimed.

After consideration of several other Texas cities, Palestine was selected because it was a railroad center, because it had an abundant supply of natural gas, because it was on a direct power line, and finally, because paved highways lead into the city from all directions. Also, Palestine's location in the state, as well as its location to its sister states, had many advantages over other cities.

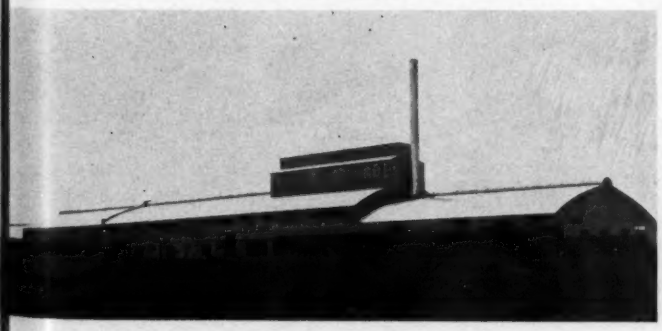
The actual site of the factory is west of Palestine, with a good mile of open elbow room between the plant building and the scattered dwellings fringing the town. Highway 79 dips along its course on the north side of the plant, and is used night and day by trucks in making deliveries of bottles from the factory. Another shipping facility is the Missouri Pacific Railroad, whose rails flank the plant on the south. The railroad has built a side track alongside the Knox factory so that cars can be loaded and unloaded at the plant's doors.

Forty-five acres comprise the Knox property area. This is adequately drained by ditching, and is well protected all round by Cyclone fencing. The grounds are reached through an electrically controlled gate, operated by watchmen who are on duty at the gate house twenty-four hours a day. Tall concrete posts, standing as sentinels, are on both sides of the gate. In the center of each is an impression of the Keystone, which is the symbol of Knox' products. The gate-watchman's house is located on the north side of the gate. Opposite to this is a parking lot for employees.



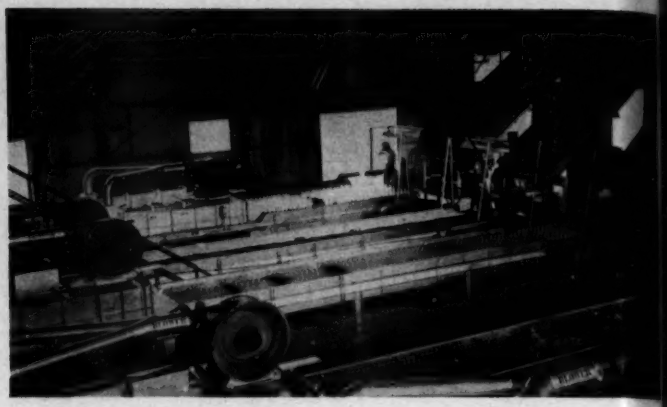
The office building as seen from the entrance to the factory grounds.

A view of the Knox Glass Bottle Company showing the Missouri-Pacific siding alongside the buildings.



The screw conveyor, running on a circular track, discharges the raw materials into their respective bins.

The front end of the tank showing the forehearthts, feeders, forming machines and lehrs. Note the arched trusses used in the construction of the building.



A view of the factory showing the lehrs, packing tables, carton chutes, and catwalk connecting the mezzanine floor and the carton assembly room.

Between the gate and the factory is the office building, of modern bungalow design. Numerous windows provide excellent lighting and ventilation. The company's private telephone system extends from here to the gate-watchman's house and to key points in the factory, which is about one hundred yards from the office.

The factory is built of structural steel, with corrugated iron roofing and sidings. Mr. A. E. Myers and Mr. H. L. Robinson, company engineers, designed it for the straight line production process. Mr. E. B. Ludwig, of New Orleans, Louisiana, handled the construction job, making full allowances for any future expansion that may be desired. A new storage unit has already been added, and was put in use during February of this year. The factory building is 780 feet long and 80 feet wide. The part of the building housing the tank, forming machine and lehrs, is 25 feet high, and the balance is 16 feet to the square. An outstanding feature of the construction is the use of arched trusses. These give better vision and more head space.

On a mezzanine floor in the center of the factory are the offices of the plant superintendent, service manager, boss packer, shipping clerk, and the testing laboratory. The offices have year-round air conditioning. From his office the superintendent can see the tank, forming machines, lehrs, and packers.

On another mezzanine floor above the packers is the carton room, where the carton making and stitching is done, and from where the stitched cartons are sent to the packing tables by long chutes.

The plant offices are on the mezzanine floor overlooking the forming machines and the packers.

The building is divided here by a fire wall connected by openings covered with fire doors, which meet insurance requirements. Beyond the fire doors the second floor is used for carton storage, the first floor here being used for the storage of ware. Cartons are conveyed from freight cars by freight elevator. All ware and cartons are handled and stored by Yale & Towne lift trucks. The entire warehouse and factory are well protected by an automatic sprinkler system.

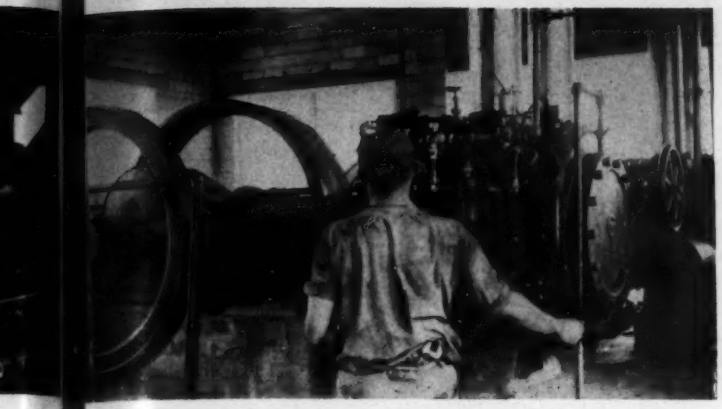
North of the factory is a tile building, 245 feet long and 30 feet wide. In this are the stock room, mould repair shop, compressor and blower room, and boiler room. The boiler is used only to supply heat to the mould shop, stock room, and packing room.

At the northeast end of the factory building is located the batch room, with its various bins of materials, and also the cullet washer and crusher.

Raw materials (sand comes from Arkansas, soda ash from Louisiana, and lime from Missouri) are stored in six large concrete bins and are unloaded by a hopper, which is located on the outside of the building. Raw materials are placed in the hopper from the freight cars by a mechanical shovel and then lifted by bucket elevator to a long screw conveyor, which runs on a circular track and handles the various raw materials into their respective bins.

Cullet is stored and unloaded into a large concrete bin, just outside the building. The cullet is conveyed from this bin by a rubber belt conveyor to a large drum-type washer, then to a disintegrator and crushed. As the cullet moves with the conveyor, pickers take out foreign substances. Finally the clean cullet reaches the storage bin.

After weighing, the raw materials are thoroughly mixed in a Ransom mixer and then lifted and carried in a large one-ton batch hopper car by a Chrisholm-Moore electric hoist to the storage bins directly above each doghouse. Through the doghouses the glass batch is automatically charged into the 90 ton tank furnace. The furnace, fired by natural gas of 1070 BTU content, was designed by A. E. Myers and erected by B. F. Morton. It is 4 port, and side-fired. The melting end is 20 feet



One of the three Chicago Pneumatic air compressors.

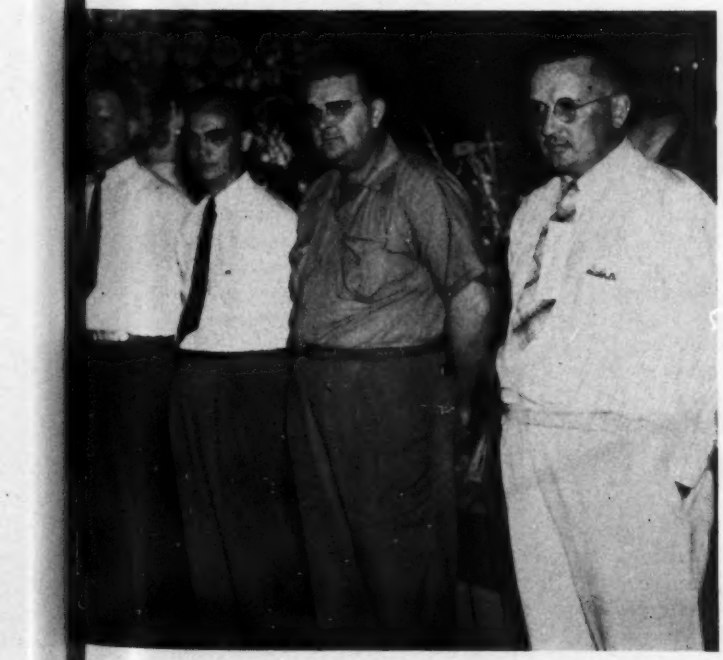
C. R. Underwood, general manager of both the Jackson and Palestine factories, making a speech at the formal opening of the Palestine factory.

wide by 22 feet long, with a 12 ft. 6 in. "metal line." Forty-two inch blocks were used.

This furnace supplies four Lynch 10 machines, a Lynch J P machine, and a Lynch J P M machine through six forehearths and feeders. As the bottles are formed, they are placed in five Hartford-Empire lehrs by Hartford stackers from intermittent Hartford type conveyors. One shop is stacked by hand, with the use of a "Peanut Roaster." After annealing, the ware is inspected and packed for storage or shipment. Types of bottles and glass containers manufactured include those used for soft drinks, beverages, foods, cosmetics, pharmaceuticals, chemicals, extracts, wines and liquors, fruit, and, in fact, glass containers of every description.

Employees of the plant are well cared for. Each has his individual locker. Showers are available for both white and colored workers. Every safety precaution is observed. Electricians, carpenters, and plumbers are on duty at all times. Landscaping and beautification work are on the agenda. Plans have already been formulated for the building of employee homes near the factory, as well as for a recreation building on the factory grounds. When this latest Knox plant went into operation on July 5, 1941, it made the eighth completed and operating Knox unit.

H. L. Robinson, company engineer; Frank C. Hicks, plant manager; John Stone, plant superintendent; and Harvey Nogar, general superintendent for the Jackson, Miss., and Palestine, Texas, factories.



When the Lincoln, Illinois and Stroudsburg, Pa., plants start production Knox Glass Associates plants will number ten in all with branch offices in all the principal cities. More than 3,000 workingmen and more than 200 salesmen now comprise what Knox officials like to refer to as "their family."

This family spirit had its beginning at Marienville, Pa., when in 1914 a small group of men laid the foundation for the Knox organization. These were the tedious, hand-blown bottle days which made the manufacture of bottles both difficult and expensive. Among the founders of that day was Mr. R. R. Underwood, now president and his brother, C. R. Underwood, vice president, of the Knox Glass Associates.

In 1917, another factory was started at Knox, Pa. In 1927 another at Sheffield, Pa. And then came the depression. In many organizations and industries, workmen were laid off and production curtailed at this time, but the Knox organization kept right on making bottles and expanding. In 1930 a new factory was built at Oil City and in 1932 another at Jackson, Miss., these two factories being known as the "Depression Factories." Then in 1935 when most industrial activity was still quiescent, Knox built yet another factory at Jersey City. In addition to the Palestine plant, two factories were built in 1941, one at Lincoln, Ill., and one at Stroudsburg, Pa. And though all these ten factories indicate a chain of successes it was not always easy sailing. There was hard work, uncertainty, and rough going over much of the time during the quarter of a century the Knox organization has been growing. Mr. Underwood, the president, indicated as much when he said:

"There is more to business than the inventories, the factories and the balance sheet, no matter how important these may be. The loyalty and devotion of my associates and the faith of my friends have compensated me for the early struggles."

THE FTC ELASTI-GLASS HEARINGS

The Federal Trade Commission's complaint against S. Buchsbaum & Co. of Chicago, the makers of "Elasti-Glass" products reached another stage in Chicago when the Respondent's Case was opened the week of Feb. 2. At previous hearings in Toledo and Washington, April and December 1941, respectively, the Commission presented expert testimony by Doctors Ryan, L-O-F; Hostetter, H-E Co; Morey, Geophysical Laboratory; and Harrison Howe, Washington, D. C. The previous testimony covered descriptions and definitions of glass over a period of two centuries or more, from that of Neri to the Tentative Definition of A.S.T.M., Committee C-14. Physical and chemical evidence was introduced to establish fundamental differences between resinous plastics and glass.

The Chicago hearing by Trial Examiner C. A. Vilas on behalf of the respondent, who has been charged with false representatians as to the nature of his product admittedly made from Vinylite, featured the testimony of Herman F. Mark, Professor of Organic Chemistry at Brooklyn Polytechnic Institute, Brooklyn, New York. Doctor Mark is an authority on the structure of matter and in the field of "High Polymers."

Dr. Mark discussed in general the structure of polymers—a material built up of many parts—and attempted to show that Vinylite, the transparent or translucent, resilient, placticized resinous material from which Elasti-Glass is manufactured was a high polymer which could not be broken down into separate parts. "A large group of inorganic high polymers are the polmeric silicates," said the witness. "They appear in the crystalline or glassy state. Selenium, Sulphur and Tellurium exist as glasses and are types of inorganic glasses. These materials are brought into the high polymeric state by mixing their constituents which usually are crystalline oxides, such as silica, lime, alkali oxides, etc., and heating them up to an elevated temperature. During this heating process," said Dr. Mark, "and while they are kept at the elevated temperature, a chemical reaction takes place, and a new compound is formed. While they are at this temperature and when they are cooled down, polymerization occurs; and the result of this process is an inorganic high polymer in the glassy state."

The witness then stated that the possibility of separating the molecules from each other at this stage was greatly reduced and that to have a high polymeric substance it was necessary that the units in the structure be atomic or molecular or some other unit.

In response to the question "What is glass?", Dr. Mark replied ". . . glass is a generic term which comprises substances in the glassy state." ". . . the glassy state or the vitreous state is the state between the liquid and the crystalline. It carries with it from the liquid state the randomness of the molecules, atoms or ions, while it has common with the crystallized state its high viscosity. I would consider the combination of these two constants, randomness and high viscosity, as the main characteristics of the glassy state." Later, he characterized a glass as having "a viscosity around and above 10 to the power 8, which is 100 million poises."

"Vinyl copolymer which under the trade name is Vinyl Brand Resins Series V, used by the respondent to make its Elasti-Glass products is a high polymer," he declared.

Dr. Mark, who was the principal witness for the respondent, tried in general to compare the material under discusion with glass and attempted to show the similarity between the two. His testimony, however, was at sharp variance with that of the Federal Trade Commission witness, Dr. George W. Morey, of the Geophysical Laboratory of the Carnegie Institution of Washington. The witness went so far as to state that amber and rubber in some forms could be called glass admitting that his definition of "glass" was counter to those of the American Society of Testing Materials. He stated on cross-examination that glass, according to his analysis, would include not only celluloid combs and belts, but also rubber baby bottle nipples.

His testimony was based in large measure upon his studies of literature and what he had gleaned from discussions with other men in the same field. Very little of the material offered by him as an expert witness was based on personal experience.

Among the other witnesses summoned to the stand by the respondent were: Greek Wells, a member of the law firm of Zabel, Carlson, Kritzbaugh and Wells; Eben Halley, Secretary and Treasurer of the Hickok Manufacturing Company of Rochester, New York; Leo H. Heimerdinger, Jr., Secretary and Treasurer of the Pioneer Suspender Co., of Philadelphia, and Donald S. Frederick, sales manager of the plastic division of Rohm and Haas Company, also of Philadelphia, and Leonard Becker, chemist of the Buchsbaum Co.

Mr. Halley, whose company manufactures belts, braces, garters, etc., under the trade name of Live-Glass, was called to the stand by defense counsel in an attempt to show that there were other manufacturers of products similar to those of S. Buchsbaum & Co. Mr. Heimerdinger, whose concern manufactures similar material under the trade name of Pliaglass, was called for the same reason.

Dr. Frederick, whose company sells a material called Plexiglass, stated that it was not the same material as Elasti-Glass. He attempted to make a distinction between ordinary types of glass and optical glass, but admitted that such distinctions as he made were traceable to his technical training and would not be ascertained by the general public. The base of Plexiglass, he said, was crystalline methyl methacrylate.

When asked by counsel for the Federal Trade Commission if he considered manufacturers of plastics in the same field as glass manufacturers he said he would not include the glass industry in the same set up with manufacturers of plastics.

The next hearing at Chicago, March 16, is expected to bring to a close a case that has been in progress of litigation since April 3, 1941 when the initial hearing was held, also at Chicago.

During the course of the hearings the Federal Trade Commission has attempted to point out that S. Buchsbaum & Co., in selling and advertising Elasti-Glass imply and represent it to be glass when there is no glass in

(*Continued on page* 114)

CHANGES IN SPECTRAL TRANSMISSION OF SODA SILICATE GLASS CAUSED BY THE ADDITION OF LAMPBLACK AND GRAPHITE

By WILLI M. COHN

Abstract. **Varying amounts of lampblack and graphite were added to a glass of the formula 1.0 Na_2O : 2.0 SiO_2. The spectral transmission has been determined in the visible region and in the photographic infrared including wave lengths 3,600 to 12,000 A. The spectral show changes in transmission, a shift of the maximum of transmission, but, as a rule, no narrow absorption bands. Similarities in the spectra of soda silica glass colored by lampblack and glucose "glass" are briefly discussed.**

Introduction

The coloring action of carbon in glass has been discussed previously.[1] Most authors assume that small amounts of carbon are present in the glass, but there still remains some uncertainty as to whether the color is due to carbon alone or to impurities present at the same time. The spectral transmission of such glasses has been investigated, so far, over rather narrow spectral ranges.[2]

This paper presents the spectral transmissions of a soda-silica glass to which varying amounts of lampblack and graphite were added. The work covers the transmission from the visible to the near infrared parts of the spectrum. The writer is aware that most additions introduce, besides carbon, impurities into the batch but he feels confident that a knowledge of the spectral transmission will eventually help in settling the controversy regarding the nature of the coloring agents.

A change in color of a glass may be due to three factors: (physically speaking), these are, (1) The appearance of sharp absorption bands (see for example, the glasses investigated by Eitel, Weyl, and Thümen[3] and Weyl and Thümen [4]; (2) A shift of the entire transmission spectrum, without change to the general transmission characteristics and (3) A change in the absorption limits at short or long wave lengths.

The Method

The tests were carried out with the first order of a Hilger grating spectrograph, dispersion 49.4 Å/mm. A lamp with straight filament served as a light source. A condensing lens concentrated the beam on the slit, the sample being placed close to the slit. The width of the slit varied from 0.1 to 0.3 mm. in different regions of the spectrum. A neutral wedge equal in length to the length of the slit was placed right in front of the slit. The wedge was practically uniform in transmission over the entire spectrum. Its density was such that the light end transmits 10,000 times the light transmitted by the dark end.[5] Wratten filters Nos. 12 or 88 were used to eliminate the overlapping ultraviolet of the second order. The measurements include both the visible and the near infrared parts of the spectrum (3600 to 12,000 Å). The following types of plates were used (all supplied by the Eastman Kodak Company): Wratten & Wainwright hypersensitive panchromatic plates, spectroscopic plates with emulsions N, K, P, M, and Z (a few spectra being taken also with emulsion Q). The plates were of sensitivities I or 144 according to the designation by Eastman Kodak Company. Before use, plates M, Q, and Z were hypersentitized by means of ammonia. The ranges of spectral sensitivity of these plates overlap which is desirable for the reduction. The plates were developed in Eastman developer "D-19" for high contrast using a brush during developing. Further precautions with regard to time of exposure, temperature of developing baths, etc., were taken as usual in photometric work.[6]

TABLE I. Data for addition of lampblack.

Glass No.	% added	Crucible	Heated to °F.	Time of heating hrs. min.	Lovibond value ***	Color
C-16	0	s*	2656	5 :28	—	Clear
C-25	1.0	s	2650	6 :04	—	Clear
C-35	5.0	s	2655	5 :42	5.3	Yellow brown
C-59	7.5	s	2610	6 :45	21.0	Brown
C-41	10.0	s	2674	6 :09	41.3	Dark brown
C-2	0	c**	2670	3 :43	—	Clear
C-26	1.0	c	2655	3 :55	7.8	Brown
C-9	2.2	c	2710	4 :17	46.0	Dark brown
C-27	5.0	c	2655	3 :55	—	Gray black

*Porcelain Crucible
**Clay Crucible
***Lovibond, Series No. 52

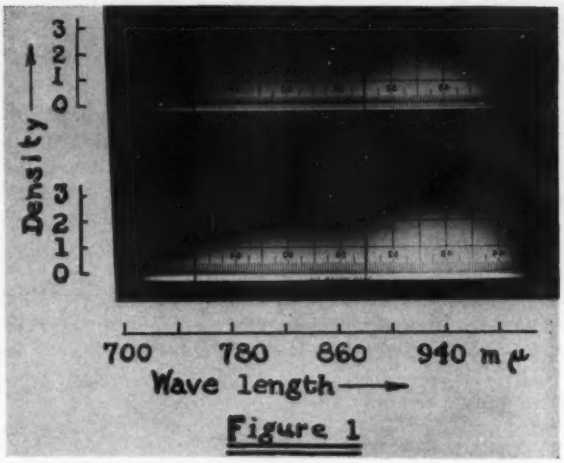


Fig. 1. Spectrographic plate, emulsion I-M; wedge spectra, top: glass sample, botttom: lamp alone; time of exposure, 5 minutes.

The scale of the wave lengths printed together with each spectrum was corrected according to the region of the spectrum investigated, the position of the plate being changed in the spectrograph for various spectral regions.

The samples were cut, ground and polished carefully. Samples were of 12.5 mm. thickness. This size facilitated the photometric reduction by keeping small the difference in the densities of lamp and glass spectra.

Each photographic plate shows one or two wedge

spectra of the glasses tested, together with a wedge spectrum of the incandescent lamp operated at a constant voltage by means of a rheostat. All spectra on a plate were taken under exactly the same conditions to obtain quantitative data. Six or more spectra were taken of each sample, the total number of spectra amounting to several hundred exposures. Figure 1 shows two characteristic spectra.

The relative density of the wedge spectra for lamp and glass was measured every 20 mμ using a print of high contrast. The ratio of the antilogarithms of the density of glass and lamp was computed and the transmission obtained at a given wave length. Curves of the transmission drawn on cross-section paper were interpolated every 20 mμ. It was found that curves determined for a certain glass in different regions of the spectrum could be readily combined. Transmission values were reduced to 12.5 mm. thickness when necessary.

TABLE II. Data for addition of graphite.

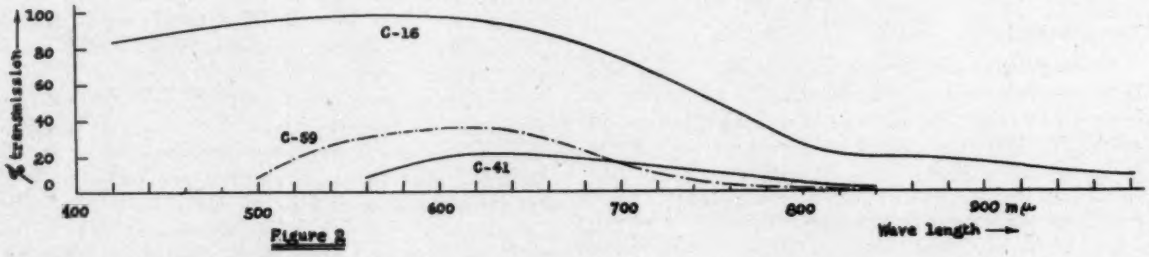
Glass No.	% added	Crucible	Heated to °F.	Time of heating hrs.min.	Color
Toulumne Graphite					
C–45	0.5	c	2660	6 :52	Light blue
C–31	1.0	c	2650	6 :04	Light blue
Ceylon Graphite					
C–44	0.5	c	2688	6 :15	Light Blue
C–30	1.0	c	2650	6 :04	Light Blue
Graphite P					
C–24	1.0	c	2655	3 :55	Green
C–34	2.0	c	2655	5 :42	Green
C–13	5.0	c	2656	5 :28	Gray black
Acheson Graphite					
C–53	5.0	s	2595	6 :18	Yellow green
C–54	10.0	s	2595	6 :18	Light Green
C–46	0.5	c	2688	6 :15	Light blue
C–47	1.0	c	2688	6 :15	Light blue
C–52	1.0	c	2595	6 :18	Green
C–48	2.0	c	2688	6 :15	Gray black

The Samples Tested

Samples were prepared according to the formula 1.0 Na_2O.2.0 SiO_2.* Carbon was added to the raw mix after preliminary tests had shown this to be more desirable than adding carbon to glass cullets; this is in agreement with Springer[1]. Samples were melted in porcelain crucibles (trade-mark "Sillimanite") using a globar kiln having a capacity for heating five batches simultaneously. Some samples were prepared in preheated clay crucibles (trade-mark "Colorado Clay") to study the influence of additional impurities on the spectral transmission, similar to conditions in industrial producton. Tables I and II present a survey of the samples discussed here.†

TABLE III. Soda silica glass, without and with an addition of lampblack; "sillimanite" crucibles; transmission Dλ in the visible and near infrared parts of the spectrum; thickness of layer 12.5 mm.

Wave length λ in A	C–16 %	C–35 %	C–59 %	C–41 %
4200	83.3			
4400	86.4	16.3		
4600	89.8	29.3		
4800	92.5	39.0		
5000	94.9	45.2	8.2	
5200	96.3	47.7	19.3	
5400	97.6	47.7	26.3	
5600	98.2	46.0	30.8	8.4
5800	98.0	43.2	33.5	14.0
6000	97.4	39.6	35.3	18.2
6200	95.7	37.0	35.5	20.3
6400	92.3	38.7	34.1	21.0
6600	87.8	40.2	29.3	19.5
6800	81.7	42.2	22.2	16.7
7000	74.0	41.0	14.9	15.7
7200	65.2	35.5	9.7	13.8
7400	55.7	28.0	5.8	11.8
7600	45.7	22.6	3.4	9.3
7800	35.8	18.3	1.8	7.2
8000	26.0	14.3	0.8	5.2
8200	20.7	10.7	0.4	3.2
8400	18.7	6.9	0.2	1.2
8600	18.2	4.2		
8800	16.8	2.7		
9000	15.3	1.3		
9200	13.5	0.8		
9400	11.5	0.7		
9600	9.2	0.3		
9800	(7.0)			



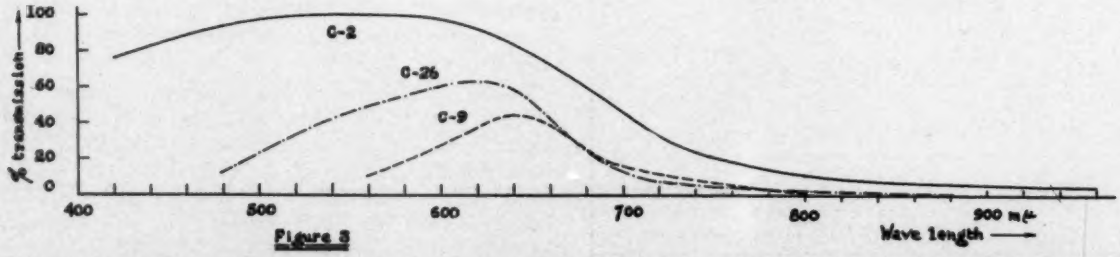


Fig. 2. Spectral transmission of soda silica glass prepared in porcelain crucibles; C-16, no addition; C-59, 7.5 per cent lampblack added; C-41, 10.0 per cent lampblack added. Fig. 3. Spectral transmission of soda silica glass prepared in clay crucibles; C-2, no addition; C-26, 1.0 per cent lampblack added; C-9, 2.2 per cent lampblack added.

The Results

Lampblack

Some results for glass samples produced in porcelain crucibles without an addition, and with the addition of lampblack to the basic formula are presented in Figure 2. The transmission is shown for various wave lengths. No narrow absorption bands were found in the entire region investigated. The curves of transmission show rather flat maxima. The transmission decreases over the entire spectrum with an increasing amount of additions. The maximum of transmission is shifted toward longer wave lengths from C-16 over C-59 to C-41. The curve of C-35 seems due to a superposition of a light-colored and a darkcolored component. Table III presents transmission values $D\lambda$ as a function of the wave length λ. Values of less weight are shown in parentheses. The probable error of the measurements amounts to ± 2 per cent.

Figure 3 shows, for comparison, curves of some glasses melted in clay crucibles. The general trend of these curves is similar to the curves of Figure 2 showing a decrease in transmission and a shift of the maximum with increasing amounts of additions. The additional impurities introduced by the clay crucible do not cause any sharp absorption bands nor do they change the general character of the curves. Table IV presents numerical values of the transmission.

Graphite

Figure 4 presents characteristic results of melts with addition of various kinds of graphite. The general shape of these curves is similar to those obtained for lampblack. Glass C-31 shows an absorption band around 4700 Å which is due to the large amount of foreign material present in the graphite as revealed by X-ray diffraction patterns. Table V presents results of some melts with graphite.

The limits of transmission were determined by taking into consideration plates of emulsion Z. Since the wedge spectra on plate Z are of less contrast than the remaining spectra the results obtained visually are given less weight than the remaining data. Table VI presents the results including absorption limits at long and small wave lengths. It will be seen that the limits of absorption at small wave lengths (as far as observed) are shifted, within the various series of melts, toward the red with increasing amounts of coloring matter. The limit of absorption at long wave lengths varies comparatively little for most samples.

A Comparison of the Spectral Transmission of Soda-Silica Glass Colored by Lampblack, and Glucose "Glass"

The spectral transmission of samples of glucose "glass" has been determined previously in the same range of wave lengths as discussed here for soda-silica glass.[7] Table VII presents some data for glucose varying in thermal history. Figure 5 shows some characteristic curves of the spectral transmission of glucose. It will be seen that the curves for glucose and for soda-silica glass prepared with lampblack are very similar. In both cases, we find a general absorption over the entire spectrum; a rather flat maximum of transmission; no narrow bands of absorption; the maximum of transmission and the absorption limit at short wave lengths are shifted with an increase in coloring matter. The relative transmission of glucose in the near infrared is somewhat higher than that of corresponding soda-silica glass most samples of which could be tested to the practical limit of transmission at long wave lengths.

The similarities of glucose and glass are very interesting since the glucose is presumably composed of one type of molecules whereas the glass is basically a sodium

TABLE IV. Soda silica glass without and with an addition of lampblack; clay crucibles; transmission $D\lambda$ in the visible and near infrared parts of the spectrum; thickness of layer 12.5 mm.

Wave length λ in A	C–2 %	C–26 %	C–9 %
4200	76.4		
4400	82.1		
4600	88.2		
4800	93.5	11.0	
5000	97.4	24.7	
5200	100.0	34.8	
5400	100.0	43.2	
5600	100.0	49.3	10.4
5800	99.6	54.8	17.9
6000	96.5	60.0	27.4
6200	91.9	63.6	37.1
6400	83.9	58.2	44.2
6600	73.2	41.7	39.7
6800	60.8	25.4	24.2
7000	46.0	13.5	15.8
7200	32.5	7.2	11.7
7400	23.8	5.7	8.7
7600	18.3	4.3	5.7
7800	14.2	2.8	2.8
8000	11.5	2.5	1.4
8200	9.4	1.8	
8400	8.4	1.1	
8600	7.2	0.7	
8800	6.6	0.3	
9000	6.0		
9200	5.2		
9400	4.7		
9600	4.7		

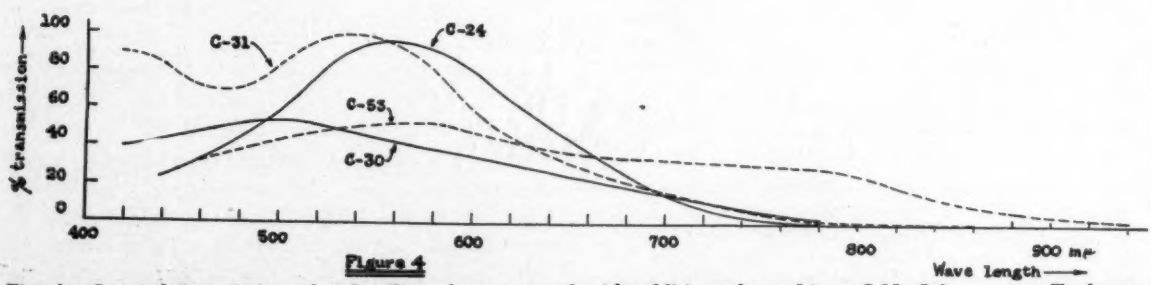


Fig. 4. Spectral tranmission of soda silica glass prepared with addition of graphites; C-31, 1.0 per cent Tuolumne graphite added; C-30, 1.0 per cent Ceylon graphite added; C-24, 1.0 per cent Graphite P added; C-53, 5.0 per cent Acheson graphite added.

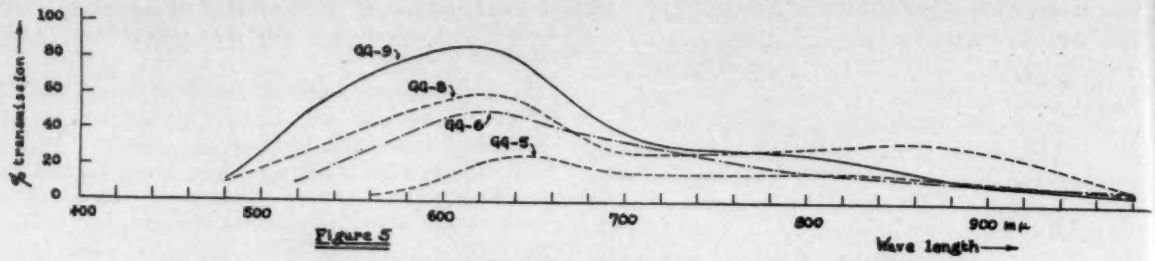


Fig. 5. Spectral transmission of glucose "glasses" varying in thermal history.

TABLE V. Soda silica glass with addition of graphites; transmission Dλ in the visible and near infrared parts of the spectrum; thickness of layer 12.5 mm.

Wave length λ in A	C–31 %	C–30 %	C–24 %	C–53 %
4200	87.6	38.3		
4400	84.0	42.2	22.8	
4600	70.0	46.0	32.8	31.4
4800	70.0	50.8	43.3	37.0
5000	80.8	52.8	57.2	42.4
5200	94.2	50.7	76.2	46.4
5400	98.0	45.7	90.9	49.2
5600	94.4	41.7	94.5	51.4
5800	80.6	37.7	90.7	51.4
6000	58.0	33.9	80.1	46.6
6200	43.8	30.0	65.0	41.8
6400	35.0	26.2	51.2	38.0
6600	27.6	22.2	38.5	35.4
6800	20.6	18.6	25.8	33.8
7000	16.6	14.7	15.1	32.4
7200	12.2	11.2	6.4	31.4
7400	7.8	8.2	2.8	30.4
7600	4.4	4.7	1.1	29.8
7800	2.0	1.7	0.4	28.4
8000	0.8			25.8
8200	0.4			19.2
8400	0.2			13.2
8600	0.2			9.2
8800				6.2
9000				4.4
9200				3.8
9400				3.4

TABLE VI. Limits of absorption of soda silica glass with addition of lampblack and graphite.

Glass No.	C–35	C–59	C–41	C–26	C–9
Limit at small wave length m λ	384	481	494	390	523
Limit at long wave length, m λ	—	977	970	991	986

TABLE VII. Glucose "glass": Color and Lovibond value.

Glass No.	Color	Lovibond Value
GG–1	Clear	3.0
GG–2	Light Yellow	11.0
GG–8	Yellow	10.7
GG–9	Yellow	12.0
GG–6	Yellow brown	14.7
GG–3	Dark brown	37.3
GG–5	Dark brown	36.7

disilicate which may contain several types of molecules. If further work shows similarities in the spectra of organic "glasses" and glass to be quite common, one may be justified in using organic "glass" more generally as a model for glass because of the greater ease of testing the organic product in the laboratory.

Summary

The spectral transmission of soda-silica glass was investigated in the visible and near infrared covering the range from 3,600 to 12,000 Å. The coloring action of lampblack and graphite are due to the shifting of the absorption limit at short wave lengths and to the shifting of the maximum of transmission. Reference is made to similarities in the absorption spectra of soda silica glass and glucose "glass."

Acknowledgment. I am much obliged to Mr. George F. Tauchmann of San Leandro, California, for help in preparing samples for spectrographic tests.

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[2]Fedotieff and Lebedeff, see above
Fuwa, see above
[3]W. Eitel, W. Weyl, and E. Thümen, Dissociation and solvation in glass based on absorption spectra. Sprechsaal **65** (36), 1932
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*Raw materials: Baker's C. P. sodium carbonate cryst. $Na_2CO_3.H_2O$ containing 0.0097% impurities including 0.001% S compounds, 0.001% SiO_2, 0.0005% Fe, 0.001% heavy metals (as Pb), 0.005% (Ca + Mg), 0.0002% N comp. (as N), 0.0005% Cl, 0.0005% PO_4; Butcher's silica sand, 325 mesh, containing 99.64% SiO_2, 0.021% Fe_2O_3, 0.19% Al_2O, containing 99.64% SiO_2, 0.021% Fe_2O_3, 0.19% Al_2O_3, 0.025% TiO_2, and trace Mg, ignition loss 0.11%.

†Analysis of lampblack: Fe_2O_3—0.04%; total ash (mineral matter)—0.88%; S—0.30%; moisture—3.96%. Three natural graphites and one artificial graphite were used, the samples from Tuolumne and Ceylon being kindly furnished by Dr. A. Pabst of the University of California; the Acheson graphite was manufactured from petroleum coke and contained 0.1% of impurities (designation "Acheson Lubricating Graphite Powder No. 38").

● The University of Washington is offering four fellowships in the College of Mines for research in Coal and Non-Metallics in cooperation with the United States Bureau of Mines. Fellows begin their duties on Wednesday, July 1, and continue for 12 months. Further details may be obtained from Milnor Roberts, Dean, College of Mines, University of Washington, Seattle, Wash.

AFTER 8 YEARS A.C.S RETURNS TO CINCINNATI FOR ITS 44TH ANNUAL MEETING

The forty-fourth annual meeting of the American Ceramic Society will be held in Cincinnati the week of April 19. Headquarters will be at the Hotel Netherland-Plaza. The starting date this year is a little later than that of recent meetings. This factor, coupled with the somewhat dislocated routine of business in general, is probably responsible for the fact that as this issue goes to press all of the papers to be presented had not been received at Headquarters and time was too short to allow for abstracting for publication certain of the papers which have been received.

In spite of all difficulties, however, it would seem from the titles and abstracts which appear following that glassmen attending the Cincinnati meeting will find much of interest in the program which is being developed.

In addition to the fourteen abstracts which THE GLASS INDUSTRY has received, there are three other paper titles on the program for which abstracts were not available at press time. These are "Experimental Estimates on Expansion of Liquid Glass at Temperatures up to 1400-1500°C." by S. R. Scholes, New York State College of Ceramics, Alfred University, Alfred, N. Y.; "Strength of Bottles as Affected by the Limitations of the Manufacturing Processes" by F. W. Preston, Preston Laboratories, Butler, Pa., and "Extinction Coefficients of Some of the Metallic Glass Colorants," by R. H. Dows and S. R. Scholes, New York State College of Ceramics, Alfred University, Alfred, New York.

General Secretary Purdy advises THE GLASS INDUSTRY that Dr. J. T. Littleton has the war defense program to develop and that progress is being made. It is expected that those attending the meeting will have an opportunity to listen to a representative of the War Production Board as well as representatives from the industries on the war emergency programs. These talks are scheduled for the afternoon of Monday, April 20, and the following morning, Tuesday, the 21st.

There may be some additions or deletions to the program before the meeting actually gets under way but the paper titles and abstracts presented in this article are substantially the program as it will be given.

While the various committees have been formed, plans for entertainment have not yet been formulated. However, the various activities are in able hands and it is certain that those who attend will not be disappointed. The various committees are as follows: Cincinnati Local Committees, R. B. Carothers, Chairman, H. C. Spinks Clay Co., Newport, Ky; Miss Mary L. Nixon, Secretary, H. C. Spinks Co., Newport, Ky; M. C. Booze, Chas. Taylor Sons, Co., Cincinnati, Ohio; R. A. Dadisman, American Rolling Mill Co., Middletown, Ohio; S. E. Eldridge, Newport Rolling Mill Co., Newport, Ky; F. S. Thompson, Corhart Refractories Co., Louisville, Ky; Ladies Entertainment, Mrs. M. C. Booze and Mrs. R. B. Carothers; Publicity, Byron Wilson, American Rolling Mill Co., Middletown, Ohio; Student and College Activities, John Douglas Co., Cincinnati, Ohio; Art Activities, H. S. Nash, University of Cincinnati, Cincinnati, Ohio.

The papers are as follows:

Is a Tank Crown Only a Roof Enclosure? *By L. S. Longenecker, Frazier-Simplex, Inc., Washington, Pa.*

Discussion of construction advantages and limitations of the sprung type tank crown. Illustrations showing some modern heating chamber applictions where the roof or crown has been changed in contour to secure better and more efficient heating. Presentation of developments which indicate that a roof or crown can be used for more than just a top enclosure over a heating chamber. Explanation as to how present roof construction has been changed to secure these improved contour lines across and lengthwise of the heating chamber. In conclusion, any of these improved features may be more generally used to improve glass tank operation.

Expansion Characteristics of Corning 96% Silica Glass #790. *By Howard R. Lillie, Corning Glass Works, Corning, N. Y.*

Expansion curves are given for samples of #790 glass from data obtained by interferometry and mechanical means. Both absolute values and those measured as differentials against fused silica are given. The effect of certain heat treatments is shown and an effort is made to explain the behavior on the basis of a simple concept of structure.

The Effect of Tin in Gold Ruby Glass. *By F. M. Veazie and W. A. Weyl, The Pennsylvania State College, State College, Pa.*

The century old use of tin compounds in the preparation of gold ruby, copper ruby and silver yellow is not based on reduction phenomena but on its specific influence on the solubility of these metals in glass.

Red Silver Glasses. *By Edward Forst, Jr. and Norbert J. Kreidl, The Pennsylvania State College, State College, Pa.*

At the interface of the vitreous phase and a halide precipitation forming therein attractive red colors are developed in glasses containing silver and halides.

Precipitated Colorants vs. Fired Colors. *By Alexander Silverman and Hurd W. Safford, Department of Chemistry, University of Pittsburgh, Pa., Pittsburgh, Pa.*

Colored glasses are usually prepared by adding a single colorant or a mixture of colorants. Sometimes this mixture is fired and sold as a "prepared ceramic color." The authors are precipitating colors of the later type from aqueous solutions and comparing effects in glass melts with those obtained with fired colors.

Studies Correlating Bottling Line With Pressure Test Breakage. *By A. Herman and H. M. Kindsvater, Joseph E. Seagram & Sons, Inc., Louisville, Kentucky.*

Since no knowledge of the relationship between the tensile strength of a bottle and its performance on a high speed production line is known, studies have been made to determine the correlation between production line breakage and a pressure test breakage. During the time that the production line breakage was being recorded, sample bottles were collected at regular intervalvs and later were subjected to a prssure test by a modified Preston hydrostatic pressure machine. In certain cases, additional samples were taken and were examined for temper by the polariscope, for resistance to thermal shock, and for cordiness by ring section analysis.

Some Effects of Lead Oxide in Glassmaking Refractories. *By A. E. Badger and C. G. Harman, Dept. of Ceramic Engineering, University of Illinois, Urbana, Illinois.*

An investigation of the possibility of using lead oxide in certain glassmaking refractories as gathering rings, forehearths, etc., for the purpose of improving the homogeneity of glass.

A Study of Photoluminescence in Glasses. *By A. R. Rodriguez and C. W. Parmelee, Dept. of Ceramic Engineering, University of Illinois, Urbana, Illinois.*

The influence of compositon and temperature on the photoluminescence of two distinct types of luminescent glasses was studied. From the behavior of their spectra, it was possible to distinguish between the two types and obtain information as to the nature of the fluorescing centers. The first type is represented by uranium glasses and the second by copper ruby glasses. Their behaviors are explained on the basis of recent atomic and glass structures.

A Study of Diffusion in Glass. *By J. A. Pask and C. W. Parmelee, Dept. of Ceramic Engineering, Univevrsity of Illinois, Urbana, Illinois.*

A study of the diffusion in a lime-soda glass of compounds of silver particularly, also halides and sulfates of gold, cobalt, copper, chromium, iron, lead, platinum, thallium, and vanadic oxide.

Effect of Various Alkalies in Glass on Electrical Conductivity. *By A. E. Badger and R. L. Cook, Dept. of Ceramic Engineering, University of Illinois, Urbana, Illinois.*

A study of the variation in electrical conductivity of glass up to 500°C as affected by changes in the relative proportions of lithia, soda, and potassia.

Structure of Sodium Borate Glass as Affected by Temperature. *By A. E. Badger and H. C. Johnson, Dept. of Ceramic Engineering, University of Illinois, Urbana, Illinois.*

An apparatus was built to study the changes in spectral transmission of glasses up to their softening temperatures. A study of the spectral transmission of a series of sodium borate glasses containing small amounts of cobalt oxide as an indicator was made using this apparatus in conjunction with a recording spectrophotometer.

Effect of Iron Oxide on the Properties of Soda-Dolomite Lime-Silica Glasses. *Contribution of General Research Laboratory, Owens-Illinois Glass Company, Toledo, Ohio.*

In two base glasses containing 16% sodium oxide, 10% dolomite lime, and 74% silica, and 14% sodium oxide, 12% dolomite lime, and 74% silica, iron oxide was systematically substituted for (a) Na_2O, (b) CaO-MgO, and (c) SiO_2 in amounts of 1, 3, and 5%. The effects of these substitutions on such properties as liquidus temperature, viscosity, deformation temperature, density, fiber softening point, coefficient of expansion, and the resistance of the glasses to dilute acid and distilled water are presented.

An Analytical Representation Concerning Glass in Its Annealing Range. *By Arthur Q. Tool, National Bureau of Standards, Washington, D. C.*

Ordinarily, simple highly fluid liquids, whenever they are being heated or cooled, assume, almost immediately on reaching any temperature, conditions that are uniquely determined by that temperature, and if no further temperature change occurs, the condition of any such liquid remains unchanged. It seems, therefore, that, as far as any ordinary test will show, all molecular readjustments that are necessary in the liquid to bring it to a condition compatible with the temperature it may have attained, are, without regard to the rate of temperature change, fully developed just as soon as the temperature is reached. That is, such a liquid, whenever heated or cooled, always follows closely a definite equilibrium curve.

This seemingly instantaneous response of all molecular readjustments to a temperature change does not occur in highly viscous liquids, and as a result, these more sluggish readjustments may be delayed until the temperature change is completed if the rate of that change is sufficiently high. In fact, it may be necessary, after any temperature change, to hold such a liquid for a considerable time, or even indefinitely at a constant temperature before its condition becomes stabilized at that temperature. By stabilizing these liquids at a number of temperatures, definite equilibrium curves can also be established for many of them.

A study of the changing properties of any one of these liquids while it is being stabilized at any temperature will show that the condition of the liquid at any instant closely approximates a condition that would be stable at some other temperature. That is, if the liquid were brought very quickly to this temperature, it would be on its equilibrium curve. A temperature which thus represents the instantaneous molecular condition of a liquid that is at some other actual temperature T) may be considered as the fictive temperature (τ) of the liquid at that instant, and it will be found that this fictive temperature continually approaches, as time progresses, the actual temperature of the liquid as an end point.

It will also be found that the time rate at which τ approaches the constant actual temperature (T) is expressed approximately in terms of $(T-\tau)$, the potential change in τ, by the relation $d\tau/dt = K'(T-\tau)$, in which the factor K' is the reciprocal of a relaxation time and a function of both T and τ, as are all other properties or coefficients of the liquid. To simplify matters, the dependence of K' on τ will be ignored for the present. Its dependence on T is expressed approximately, in many cases, by the relation, $K' = Ke^{T/k}$, in which K and k are presumably constant for a particular liquid. Introducing this assumed equivalent of K' into the above relation for $d\tau/dT$ yields an expression which presumably holds even when T is changing. If T is changing at any rate, $R = dT/dt$, the temperature rate of the change in τ at any temperature is given by the relation $d\tau/dT = (K/R)(T-\tau)e^{T/k}$.

If R is constant and the substitution, $X = \pm (Kk/R)e^{T/k}$, (the double sign makes x positive even when R is a cooling rate) is used, the solutions of this differential equation are

$(T-\tau)_h = ke^{-x}(Ei(x) - Ei(x_h'))$ (for heating)

and

$(T-\tau)_c = ke^{x}(Ei(-x) - Ei(-x_c'))$ (for cooling).

In these relations x_h' and x_c' are the values of x when $(T-\tau)=0$.

By using tables of the exponential integrals, Ei(x) and Ei(—x), values of τ for all temperatures (T) are computed easily for any heating or cooling, provided K, k, R, and one value of τ (such as τ_0 at T_0) are known. Moreover, if the expansivities (a) and (a′) are known (a being the coefficient for the expansion occurring when τ is constant and T varies, and a′ being the coefficient for the expansion occuring when T is constant and τ varies), it is possible to compute expansion curves for any rate of heating or cooling. Similarly, if the corresponding specific heats, s and s′ are known, it is possible to obtain heating and cooling curves which show extraordinary endothermic and exothermic effects in certain temperature ranges.

If the coefficients employed throughout the computations approximate those of ordinary glasses, the similarity between computed and experimental curves is very striking. The chief discrepancies between these curves appear to be the result of the assumption that K' is independent of τ. However, despite all discrepancies arising from simplifying assumptions, the great similarity between the two sets of curves makes it appear that the behavior of an ordinary glass in its annealing range differs very little from the behavior of an extremely viscous liquid. That is, much of the molecular readjustment in an ordinary glass when it is being annealed or disannealed is in its nature not materially unlike the molecular readjustment that occurs in many highly fluid liquids when they are being cooled or heated; but in a highly viscous liquid or glass this readjustment is so greatly retarded by the high viscosity that, before it develops, the materials can be cooled to low temperatures where it is delayed indefinitely.

An Apparatus for Recording the Movement of Interference Fringes. *By J. B. Saunders, National Bureau of Standards, Washington, D. C.*

In measuring thermal expansions by the interferometric method, it is usually necessary to make observations at short intervals over periods of time lasting several hours, and to obtain the data desired in certain special cases it may be

(*Continued on page* 114)

COMMERCIAL ART GLASS

By LEO MOSER

In this presentation a series of original modern Bohemian (Czecho-Slovakian) art creations are demonstrated which became the starting point of some lines of modern European "Commercial Art Glasses."

The author presents suggestions for the application of new American methods to the production of this type of ware. In view of the present world economic structure, temporary shortages and priorities, this article dealing as it does with "luxury" ware, may seem to be somewhat inopportune. However, it may be worthwhile at this time for the American glass manufacturer to look ahead and make plans for post-war developments.—The Editor.

American glass industry leads the world in methods of manufacturing glass by machine, and encompasses nearly half the world production. There can be no doubt, that the glass industry of the United States is well equipped to lead in research and production of art glass in spite of what will follow the present economic, industrial and political conditions.

This new artistic glass—let us call it "Commercial Art Glass"—should by no means, be produced as, for instance, some of the well-known high-grade lines. Steuben Glass, to name one, is individual art production, and for that reason it is expensive and will be available for a limited number of people only.

The new "Commercial Art Glass" line should be produced to retail up to $25.00, so that a larger part of the public should be in a position to acquire pieces of this category.

The "Commercial Art Glass", and this should lead to the correct interpretation of this term, developed slowly and through the centuries. Originating from the ancient shapes of the Egyptian, Persian, Phoenician and Roman glass objects, each of these an individual art creation, with the outstanding example of the "Portland Vase", the developments lead up to present time art glass creation of the styles of Tiffany, Lalique and others.

A better illustration and understanding will be given by the pictures, which show how far commercial glass manufacture and glass styling everywhere have been influenced by products of modern glass art. The pictures are illustrations of modern art glasses. Numbers 6 to 9 represent samples. The peculiarities of shapes and their expensive technique of manufacture do not permit a lavish reproduction at low cost. However, the styling of many inexpensive glass manufactures has been influenced by these shapes, designs and ideas incorporated by them.

The two vases and bowl in photograph No. 1 suggest a new kind of cutting. The surface of the glass objects has not been distorted by irregular and deeply cut, geometrically arranged ornaments, but wide panels, delicately outlined, follow in their simplicity the well proportioned shape and thus emphasize the intended line of the style.

The same style of cutting has been used for a larger flower vase as shown in picture No. 2. Shapes and style of cutting as demonstrated in pictures No. 1 and 2 have found wide recognition and have apparently given the basic idea for many duplications in commercial art glass as well as in machine made and pressed glass ware.

The same style of cutting has basicly been applied to the bottles in picture No. 3, and this goes to show what variety of effects can be achieved by simply applying this and possibly other modern types of cuttings on a wide enough range of shapes.

A number of vases in different shapes, as illustrated in photograph No. 4, gives evidence of one of the most peculiar but also most attractive styles of cuttings. Wide, deep brilliant carvings, layed out diagonally and vertically towards each other, create brilliancy effects that no photograph could possibly bring to reality. If used in connection with high grade quality blanks, or such colored by rare earths, this style of cutting is one of the most outstanding of the latest creations.

Doesn't photograph No. 5 give you the impression as though you would be confronted with a piece of rock crystal that came out of the mine just as it is? Actually,

Fig. 1. Cut vases and bowl.

Fig. 2. Cut flower vase.

Fig. 3. Cut bottles.

Fig. 4. Attractive cutting of vases.

a simple piece of rock crystal once caught the attention of the designer and there was the idea of this, let us modestly say, quite unusual piece of art glass. The technique applied is not complicated. The best result will be achieved by using a lead crystal blank. The cuttings are deep and half deep and absolutely irregular, this giving the impression of a piece of rock crystal that has not been tampered with, and naturally, no polishing process has been applied. All the cuttings on this piece are smooth.

A rather definite idea, stunning in its simplicity prevailed when the artist received his inspiration to his brainchildren, the two vases in photograph No. 6 and No. 7. Whereas No. 6 tends to portray a wide and calmly burning flame, we find that No. 7 idolizes the tindery, upshooting fire, the "Magic Flame".

The predominant feature of the glass objects as shown in photographs No. 8 and No. 9 is their deliberately indefinite shape. No matter, what we want to make, either a bowl or a vase or anything else, this technique can be applied and the results will, doubtlessly, delight everybody. Basically, it is nothing new. New is the idea however, to manufacture such items from glass. Whole druses of rock crystal, as far back as the 17th century, have been carved into precious gift and ornamental items. To adopt these styles for the creation of art glass lines was a comparatively easy matter.

Although this statement is a repeat of a previous remark, the point must be stressed again that the items as illustrated with photographs No. 6 to No. 9 are not destined to be utilized for commercal art glass on account of the comparatively high manufacturing costs. Nevertheless, intelligent deviations from the originals in styles, designs and the way of application could make some of these ideas adaptable to commercial art glass manufacture.

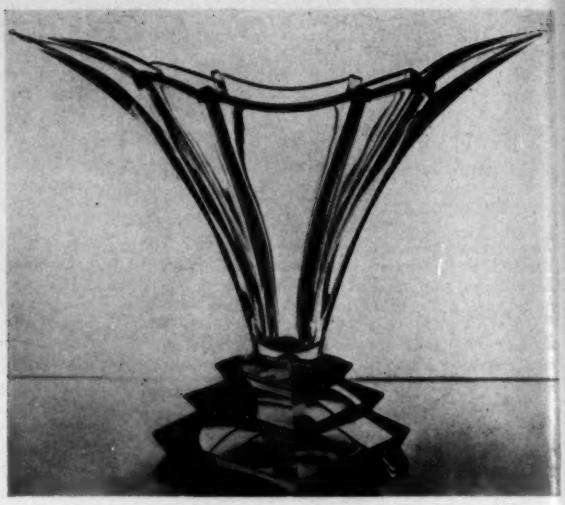


Fig. 6. Flame cutting of vase.

Many manufacturers in this country object to the manufacturing of hand made "Commercial Art Glass" and their objections are based on, supposedly, high labor cost. Granted that labor cost in the United States is not only comparatively, but also absolutely higher than anywhere else. In spite of these facts no discouragement should dominate and I venture to prove by an example from my own experience, that manufacturing costs can be brought down to a reasonable level, if the right manufacturing methods are being applied.

In 1923 I had the honor to present to the Pope in the Vatican a complete set of fine drinking glasses with bottles, each piece with the Pope's Coat of Arms. Needless to say that this set was specially designed and that particular care was taken as to styling and perfection and that money was no object. Picture No. 10 gives a view of the set.

Publicity throughout the world did not fail to stimu-

Fig. 5. Irregular cutting of "rock crystal."

Fig. 7. "Magic flame."

Fig. 8. Indefinite shape.

Fig. 9. Indefinite shape in a bowl.

late a really popular demand for this style of table ware. Obviously, the interested public turned to the source of origin and asked vehemently for reproductions but at popular prices. Thus, I was faced with the problem of manufacture this line in a more industrial way although originally created for highly skilled labor.

The number of skilled workers who could do the job was very limited. The entire crew that could be trusted with such a highly delicate work consisted of only four men. Complaining could not get me anywhere. I soon found out that if I want to make this set at reasonable cost, I must change the manufacturing methods without infringing upon quality.

In order to achieve the maximum of both quality and manufacturing output I had to analyze carefully the entire procedure in every step of production. This led to the conclusion that the manufacture must be broken up into single operations and that a constant flow must be created. A special tool was developed for each man and for each individual operation, so that each man was to do only one, comparatively, simple operation. Thus, a result was achieved which surpassed all expectations. The output was almost threefold against the original production. The price was brought down to such a low level that the inpouring orders made it necessary to increase the staff from originally four men to thirty men who were kept busy on this one line only.

The past has proved that the American glass industry is capable of following an original path of development. The outstanding example which confirms this statement is best illustrated by the substitution of the European hand cut stem. The pressed stem, commonly described as the "Hokey-Pokey" stem does not only prove to be considerably cheaper in manufacture but enables the stylist to create designs and shapes which could never be made by hand or in the European way. The obvious consequence was a remarkable decline of imports in stemware during the last few years. A well known fact is that the American pressed glassware is superior to any imported pressed ware. These facts are encouraging and I do not see why the hand-made industry should not want to follow the leadership as demonstrated in the other branches of the glass field.

Comparisons cannot do any harm. No lead crystal glass had been produced in Central Europe prior to 1914; all lead crystal had been imported into Central Europe from the U. S., England, France and Belgium. After the first World War, rather after 1919, the imports of lead crystal into Central Europe were practically zero. This does not indicate that no lead crystal has been purchased or sold. On the contrary, the sale of lead crystal increased considerably but everything was already home-made. If we compare with Czecho-Slovakia, we must say that adjustments in the production methods have always been made rapidly and in accordance with market requirements. When, for instance, French and Finnish factories flooded the world market with goods at ridiculously low prices, the Czecho-Slovakian manufacturers had to accept the challenge of the reduced selling prices. Profits may have been reduced, too, but in the first place new methods have been devised that resulted in cheaper production costs. Even, if there is nothing new in such endeavours, they are merely to indicate that the desire must prevail and that ways can be found to solve such problems. The Swedish and Dutch Glass Industries, with almost equally high wages. (In comparison with living costs in these countries, these wages are high.) As the American glass industry, 25 years ago adjusted their production methods in such a way as to meet the world markets' demands and worked themselves into a position of leading style creators.

What could be achieved with "Hokey-Pokey" and in the entire pressed glass industry of this country, can, no doubt, also be achieved with "Commercial Art Glass", although this may take a little longer. Existing and known methods can easily be combined with new ones, new tools can be devised and new appropriate designs can be created and if everything is carefully handled and practically devised, high wages can be counterbalanced. Thus, the hand made glass industry in the United States could surely assume the leadership in "Commercial Art Glass", another step towards cultural achievements.

Fig. 10. Bottles and glasses presented to the Pope.

• An asserted monopoly of the right to burn oyster shells in rotary kilns for the purpose of making high test carbon dioxide and lime has been broken, according to an announcement of E. M. Allen, president of The Mathieson Alkali Works. On February 9th the Supreme Court of the United States refused to review the decision of the Circuit Court of Appeals for the Fifth Circuit in the case of W. D. Haden Company vs. The Mathieson Alkali Works, Inc., which was favorable to Mathieson.

WANTED

A small offhand manufacturer to make Perfume Bottles and Stoppers in good quantities. Write Box 48, The Glass Industry, 11 West 42nd Street, New York City.

INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During January

Compositions

Methods of producing articles of silica have been covered by two recent patents, the ware being made by sintering rather than by completely melting pure quartz. These are patents 2,268,589 granted to John A. Heany of New Haven, Conn. (Heany Industrial Ceramic Corp., Rochester) and 2,270,718 granted to Franz Skaupy, of Berlin-Lichterfelde-West, and Gustav Weissenberg of Berlin-Mariendorf, Germany. In both instances it is generally proposed to form the ware before it is sintered. The Heany process begins with the preparation of a "reactive and readily vitryfying finely divided silica" obtained by burning a gaseous or liquid compound of silica. Examples of such compounds are silico-chloroform ($SiHCl_3$), silicomethane (SiH_4) and ethyl silicate, $Si(OC_2H_5)_4$. When the products of combustion are brought into contact with a cold surface, the finely divided silica is collected as a fine powder. Heany then makes a casting slip or molding batch from this powder and forms tubes or other articles by such methods as casting, extrusion and pressing. It is reported that such articles need be fired at 1200 to 1450°C (far below the melting point) for only a short time to develop a non-porous structure.

The new Skaupy-Weissenberg process also avoids fusion. Products molded from finely powdered quartz and a plasticizer are dried and then sintered on a schedule which allows them to be above 1470°C for only a few minutes. This is to minimize the formation of cristobalite which has undesirable expansion characteristics. Many alternative sintering methods are outlined in this patent. The inventors propose in one instance to press the sintered shaped bodies while hot to reshape them.

Furnaces

Figure 1 shows one view of a glass melting furnace described in patent 2,268,546 granted to Samuel A. Forter of Avalon, Pa. (Forter-Teichmann Co.). This comprises an upper rotating melting furnace from which the glass overflows into a lower refining chamber. The upper furnace is made in two parts so that the cap and upper-structure are stationary and only the hearth rotates. The glass makes its way through inlets 30 to a center well and then descends to the refining tank as ribbons or streams flowing down a tube 7. Fuel and air for combustion are supplied both to the melting chamber and to the refining furnace, the burners entering the upper furnace tangentially.

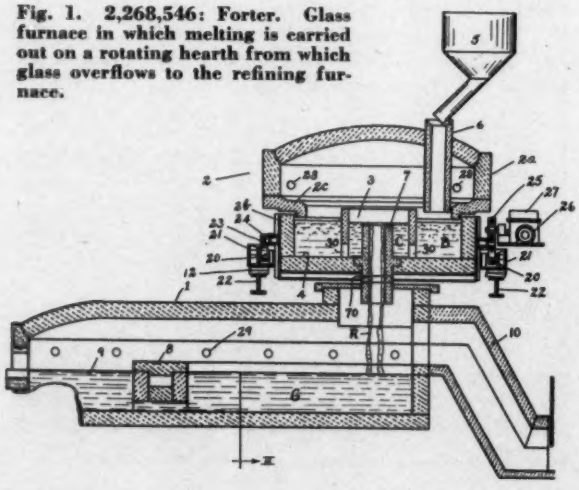


Fig. 1. 2,268,546: Forter. Glass furnace in which melting is carried out on a rotating hearth from which glass overflows to the refining furnace.

George Easter of Niagara Falls (The Carborundum Co.) received patent 2,269,445 for a new type of furnace wall with material within the joints of tank blocks which reacts with any penetrating glass to stiffen it. He states that diatomaceous earth and powdered quartz are materials which would work in this way since they "react with most glasses to form high viscosity products." Fine alumina is reported to be a suitable stiffening agent to use in the joints of boro-silicate tanks.

Feeding, Forming and Shaping

Shears for continuous forming processes were described in patents 2,271,271 to George T. Meyers of Parkersburg, and 2,271,004 to David E. Gray of Corning (Corning Glass Works). The new Meyers shears are shown in Fig. 2, where the upper ring portion is lifted out of position to show the shear blades 34. Operation is brought about by the movement of the rack bar 14 which meshes with teeth on the upper ring. Slots 42 in this ring which are fitted over pins 43 in the shear blades, are cut at such an angle as will operate the shears when the upper ring is rotated by the rack bar. In the Gray patent the glass charge is severed by pairs of shear blades mounted on vertical rotating shafts on either side of the glass outlet. One blade is moving at a faster rate than the other when

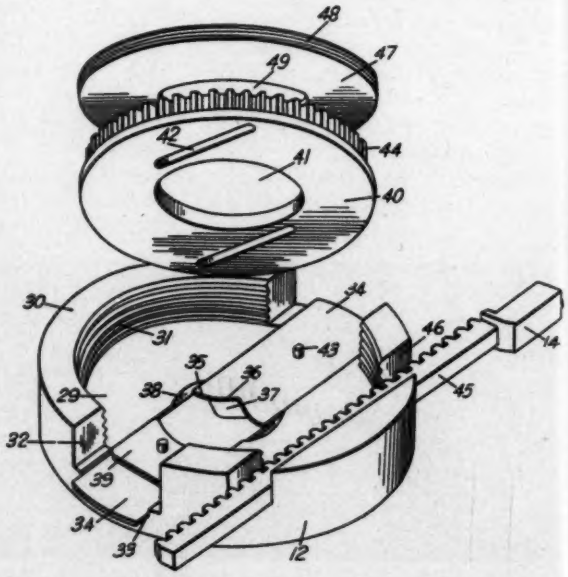


Fig. 2. 2,271,271: Meyers. Shear driven by a rack bar.

the charge is severed, so as to give the gob an impelling force in the same direction as the movement of the molds into which the gobs drop.

Russell G. Allen of Alton, Ill., assigned to Owens-Illinois Glass Co. his patent 2,269,391 for improvements in an Owens type forming machine. It is concerned with the provision of adjusting apparatus for controlling the cams which adjust the time of the individual operations performed by the machine. The controls automatically start and stop the motor by which the cams are separately adjusted.

Fig. 3 shows the method for forming stemmed glassware, which is disclosed in patent 2,269,010 granted to Andrew J. Cunningham of Snyder, N. Y., and asisgned to Alfred H. Sharpe of Buffalo. The process consists of marvering glass on a blow tube into the approximate form of the bowl and stem portion of a goblet, blowing it into a mold of proper shape, pressing a charge of glass to form the solid stem portion 22 and to fuse it into contact with the hollow stem portion; subsequently the button of excess glass on the solid stem is reformed into a foot. In the upper view, 16 is a gate which is held in place only until the upper bowl portion is blown.

George Roessler of East St. Louis, Ill., has developed a new machine bottle blowing method described in a jumbo sized patent (2,269,553) which has eighty-one drawings. No one view can be selected which adequately tells his story but the individual forming steps will give an idea of the novel nature of his process.

The entire shaping process is carried out in a single mold which is held in neck-down position, with the bottom forming plate initially slid aside to allow the gob to drop into the mold. Immediately a blow-down head is closed tightly on top of the mold and compressed air forces the gob of glass down into the mold to form the finish, or neck and shoulder portions. During this time, the contact of the walls of the mold with the glass stiffens the nearest glass so that when the next step of blowing upwards from the neck begins, this stiffened layer adheres to the mold, and the center and hotter glass is blown upwards to spread off over the mold walls. This blow-up begins with a short puff to extend the upper edge of the glass only slightly and thus to eliminate what otherwise might be a "high water mark." Then a full charge of air causes the inner and molten part of the glass to roll upwards along the sides of the mold, and finally a quick final upward charge of air forces the last part of the glass against the bottom plate which actually is the top of the mold, forming the bottom of the ware and giving a complete bottle.

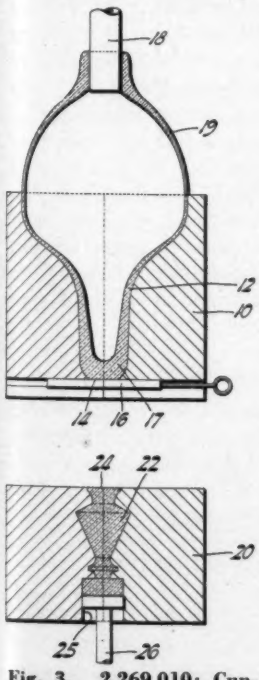


Fig. 3. 2,269,010: Cunningham. Hollow stemware made from a pressed base and blown top.

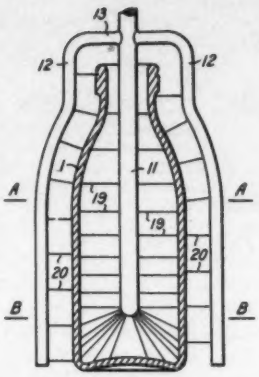


Fig. 4. 2,269,060: Mitford. Air blast for tempering is concentrated within the bottle and especially at the bottom.

Mr. Roessler directs his invention toward eliminating the variation in wall thickness in bottles formed by usual methods. These differences he largely attributes to the fact that in all bottles except round ones the glass is thickest in those portions where the mold is first touched by the glass, and where contact with the cool mold walls is therefore for a longer period. In his process all portions of the mold in any horizontal cross section are obviously touched by the glass simultaneously. He does, of course, have the problem of correcting for the longer dwell of the glass in the neck portions of the mold. Toward meeting this problem he has introduced a number of controls including slots in this portion of the mold to reduce the mass of metal. Water cooling might be concentrated in the upper section of the mold to cool more readily that portion and equalize its thickness with the neck of the bottle.

Miscellaneous Processes

Patents 2,271,038 to Wm. L. Shaver of Corning, and 2,269,060 to John B. Mitford of Rainhill, England, are the latest additions to the Corning Glass patents on methods of tempering glass articles. The Shaver patent provides a liquid bath (such as a mixture of sodium and potassium nitrates) in which a temperature gradient, for example from 680°C to 250°C, is established between different parts of the liquid. To temper an article, such as a dinner plate of ordinary lime-soda glass, it is supported in a carrier and lowered into the upper and high temperature zone of the liquid to become heated to near its softening temperature; afterwards the carrier is rapidly lowered to the bottom of the bath where it is allowed to remain for the few seconds required to cool the plate to the temperature at which the glass becomes rigid enough to suffer no release of stress. Subsequent cooling to room temperature has no effect on the temper of the glass and may take place outside the liquid.

The Mitford patent is illustrated in Fig. 4 with respect to a heated bottle which is undergoing air blast from inside and out to give it the desired temper. The single lines 19 and 20 give a graphic method of illustrating the differences in intensity of the blast and in the number of air jets directed at different parts of the bottle. The essence of the invention is the use of more air to chill the inside than the outside, and a concentration of jets at the inside bottom of the bottle. The outside needs less direct blast because it cools by radiation to the surrounding room, and the upper inside portions require less blast than the inside bottom since all of the air from the bottom jets must pass out of the bottle over the upper sections of the wall.

In another Mitford patent, 2,269,597, this time assigned to the American Securit Co., a technique is outlined for treating tempered articles having unequal thick-

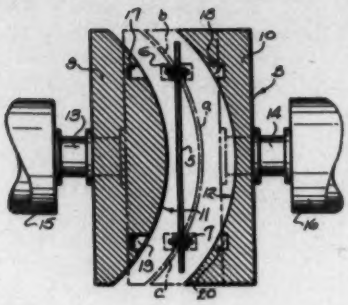


Fig. 5. 2,270,470: Paddock. Bending glass sheets in an apparatus which has recesses to receive the tongs.

ness. The quenching treatment may have left such articles with an unequal temper so that the stress at one point may lead to spontaneous rupture. According to the invention the tempered article is reheated for a period which will tend to equalize the stress without destroying the temper. The presence of unequal stresses can be determined by a thermal shock test. If a heat treatment is found to be needed to correct such a condition, the correct temperature is found by a trial and error system. For example, 380°C for 12 hours might be tried first. If the articles then withstand the shock test and on fracture still give small particles indicating that the tempering has not been destroyed, the treatment may be considered satisfactory. However, if the size of fragment has increased, say from ⅛ inch to an inch in length, obviously too much temper has been removed, and a lower temperature is indicated as advisable for strain equalizing purposes.

Patent 2,271,334, granted to Robert E. Fosdick of Dayton, Ohio, is concerned with a lens grinding machine. Patent 2,271,239 to Howard W. Vokes of Rochester (Eastman Kodak Co.) refers to apparatus, such as that described in the McRae patent 2,263,008 described in the January, 1941, GLASS INDUSTRY, for holding lenses within a vacuum chamber where metal fluorides are volatilized to their surfaces to prevent Fresnel reflections. Vokes' new discoveries consist largely in his finding that the holder parts can be cleaned more readily if they are plated with nickel or chromium, and if these parts of the apparatus are so designed as to minimize the areas which receive fluoride directly from the electric filament which volatilizes the fluoride.

A lehr of the so-called "calorimeter" type was patented by Donald G. Merrill of West Hartford, Conn. This was patent 2,268,609 assigned to Hartford-Empire Co. Hot gases introduced at the entrance end of the tunnel, circulate about the ware on an open-ware conveyor, and there is cooling circulation at the exit end. In an intermediate section of the lehr there is a cooling zone in which cooling gases are circulated through muffled walls which have higher conductivity at the bottom, so that more heat is extracted from the bottoms of the ware. Without such provisions the heat is retained longer in the thicker bottom sections.

Patent 2,268,666, granted to Edmund Löpp of Berlin (C. C. Lorenz Aktiengesellschaft, Berlin-Tempelhof) provides a method of fusing a glass cylinder to a ceramic tube.

Sheet and Plate Glass

Fig. 5 shows a detail of Ormond H. Paddock's process of patent 2,270,470 for bending glass sheets (Libbey-Owens-Ford Glass Co.). The main feature of the invention consists in his being able to have the entire sheet within the area of the bending surfaces, this being accomplished by the provision of recesses or notches 17-20 for receiving the hooks or tongs 6 and 7.

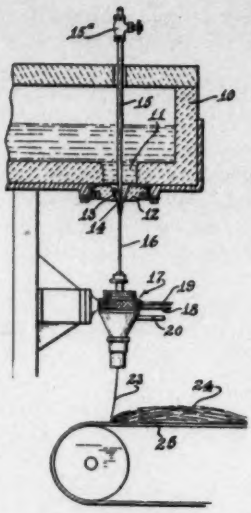


Fig. 6. 2,269,459: Kleist. Small glass tubing formed around mandrel 15 is reheated and blown to extreme fineness at 17.

Another Libbey-Owens-Ford patent granted during January was 2,270,462, which describes a template glass cutting machine invented by Joseph R. Morris of Toledo. The machine simultaneously cuts out a number of plates such as windshields. The tools do their cutting around the outside of the templates rather than the inside, and by this means room is made for the positioning of more templates on a sheet of glass than would be possible with some similar machines.

Pilkington Bros. Ltd. of Liverpool, England, received patents 2,270,362 and 2,270,244 for glass strip polishing machines. The inventors were F. B. Waldron, G. H. Baillie and P. M. Hogg, the latter participating only in the first patent. Both patents are concerned with means for driving continuously formed strip through the polishing apparatus. To avoid the breakage of the strip due to abnormal tension caused by the rolls, both patents provide the rolls with a relatively constant torque. In 2,270,362 this is accomplished by driving the rolls by an induction motor, and in 2,270,244 each roll is driven by a torque device which utilizes a weight or spring.

Patent 2,271,377, assigned by George Monnet of Paris to The American Securit Co., describes jets used in applying the air blast for tempering glass sheets. Another American Securit tempering patent is 2,271,373, granted to Bernard Long of Paris. To provide a sheet with different amounts of temper at different points, an even temper is first introduced and then strain is removed from a selected zone by the localized application of heat. One of Long's earlier patents on this subject is 2,244,715 discussed in the August, 1941, GLASS INDUSTRY.

Glass Wool and Fiber

A method of producing extremely fine tubular fibers is shown in Fig. 6 from Dale Kleist's patent 2,269,459, assigned to the Owens-Corning Fiberglas Corp. A tube of fairly small diameter is formed around the mandrel 15 and is then directed through a drawing instrument 17 where it is reheated and drawn out or blown to a hollow fiber or microscopic tube 23. The drawing apparatus may be similar in construction to a conventional spray gun or to the machine known as a metal layer machine. A burner within it is supplied with fuel gas through pipe 18, while air for combustion enters through 19. Pipe 20 supplies the air for blowing the fibers.

(*Continued on page* 114)

Research Digest

Practical Interpretations of Glass Technology

The Influence of Boron Oxide on Expansibility

Much misunderstanding still exists as to the effect of boron oxide in lowering the expansibility of glasses. Many glassmakers still feel that there is a sort of magic about this material, and that it needs only to be included, to some extent, in a glass composition, in order that expansibility may be greatly reduced, and thereby the thermal endurance of the glass may be greatly improved.

On the other hand, many glassmakers and, in fact, most of those who have kept in touch with the literature on it, realize that the effect of boron oxide is a peculiar one. Small amounts have a great influence in lowering expansibility. A larger proportion (exceeding the soda content of the glass) begins to have the opposite effect. As Morey maintains, it is incorrect to speak of this as the "anomalous" behavior of boron oxide. There is no real reason behind the assumption that the effect of any given oxide upon a physical property of glass will be directly and continuously proportional to its percentage of the mixture. It is, therefore, a short-coming of the additive theory and not anything necessarily unique in the nature of boron oxide that gets us into a confused state of mind when we try to calculate what its effect will be.

It is now well understood that when small additions of boron oxide are made to an ordinary soda-lime glass, the co-efficient of expansion is reduced so sharply that it is as though the boron oxide itself contracted, rather than expanded, with rise of temperature. Accordingly, English and Turner, after studying a long series of glasses containing boron oxide, arrived at the conclusion that it was justifiable to give this component a negative factor in calculations, that is: —0.66 x percent B_2O_3 present, served to estimate with fair accuracy the probable coefficient of expansion. However, if the percent B_2O_3 was increased beyond half the percent Na_2O, the calculated value for coefficient of expansion became progressively too low, until, when the percent B_2O_3 exceeded percent Na_2O, calculation by means of the above factor was useless in predicting anything like the true value.

When a glass of the Pyrex resistant type is under consideration, a suitable factor for B_2O_3 is *plus* 0.73 a specimen calculation would then look as follows:

Oxide	*% factor*		*products*
SiO_2	86 X .05	=	4.05
Na_2O	4.5 X 4.32	=	19.44
Al_2O_3	2 X 0.17	=	.34
B_2O_3	12.5 X 0.73	=	9.12
Coeff. of Exp. = 32.95 X 10^{-7}			

Glasses whose compositions lie between the unusual one just cited and the more ordinary soda-lime glasses with small amounts of B_2O_3 must require, for the estimation of coefficient of expansion, a factor for B_2O_3 lying between the numbers given. If alkali should be entirely absent it is probable that a rather large factor would have to be applied. Information is lacking as to the possible effect of bases such as: PbO, CaO, and others of the RO type. Finally, a glass composed entirely of boron oxide has a coefficient of expansion in the neighborhood of 145 x 10^{-7}. A little soda added to the boron oxide glass causes a steep reduction in the coefficient of expansion. Here, in terms of additive theory, it looks as though soda should have a negative factor. This abrupt descent continues until the ratio $Na_2O:B_2O_3$ is about 1:4. (Scholes, *Modern Glass Practice*, 1941, P. 229) Scholes attempted to relate this circumstance to some sort of chemical combination of soda and boron oxide in the glass, pointing out that soda has no such effect when it is added to silica but, on the contrary, that it steadily increases the expansibility of a silica glass with increasing soda content, very much in line with the additive theory. This postulate of a compound in the glass seems to be untenable, or at least beyond any demonstration, in our present state of lack of knowledge concerning the constitution of liquids.

A reasonable explanation of the effect of soda in lowering the expansibility of B_2O_3 glass is offered by Warren (*Jour. Amer. Ceram. Soc.* 1941, P. 260). His x-ray investigations indicate that the coordination number of boron (toward oxygen) changes from 3 toward 4 as sodium is added, with a consequent lowering of expansibility. It is interesting to note that the density undergoes a similar change.

Although we have, as a result of Warren's work, a rather satisfactory explanation for the behavior of boron oxide in ordinary glasses, we must be more than ever convinced that it is not possible to derive a simple factor for this oxide in the calculation of any specific physical property. All the evidence seems to show that the additive theory cannot be applied to this oxide without very large errors. The point becomes more clear when we consider the work of Turner and Winks and their curve showing the effect of boron oxide on linear expansion (*Jour. Soc. Glass Tech.* 1925, P. 397). They have shown that the effect of boron oxide is far from being a linear function such as the additive theory postulates.

Since predictions by calculation are practically useless, we must fall back upon separate determinations for various ranges of composition. This is particularly true for the low-melting enamels used for decorative purposes, where comparatively little silica or soda is present. It is far better not to trust the factors at all, and to rely upon the trends in expansibility as shown by actual determination at several stages in a given range of composition.

L-O-F TO PRODUCE PRE-FAB HOUSES

Acting with the government to relieve the acute shortage of adequate low cost housing for defense workers, Libbey-Owens-Ford Glass Company will soon be producing several hundred prefabricated, demountable defense houses per month in its Ottawa, Ill., plant, providing work for approximately 600 employees.

CURRENT STATISTICAL POSITION OF GLASS

During January the glass industry maintained the high rate of operations of the previous month; production, employment and payrolls reached record levels for this period of the year. According to THE GLASS INDUSTRY's Production Index, output during January was valued at $43,000,000 as compared to $34,000,000 in January 1941.

Plate glass production during January totalled 9,143,983 square feet according to the Plate Glass Manufacturers of America. This was 11 per cent less than the December total and 53 per cent under the January 1941 production.

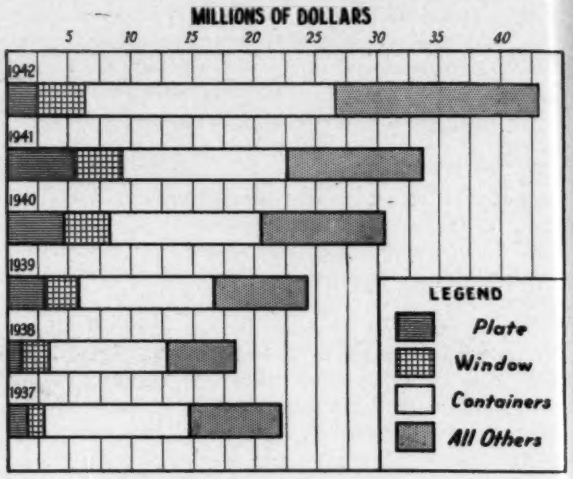
Window glass production during January totalled 1,638,700 boxes. This was 4 per cent less than the previous month's volume but exceeded January 1941 by 5 per cent. During January the window glass industry operated at 100.9 per cent of its rated capacity.

Glass container production during January amounted to 6,754,515 gross according to the Glass Container Association of America. This was 11 per cent greater than the December total and exceeded January 1941 by 49 per cent.

Shipments of glass containers during January totalled 5,876,818 gross or 41 per cent more than the January 1941 volume. Outstanding gains were reported over last year's corresponding month for beer bottles, which increased 298 per cent, domestic fruit jars 234 per cent and domestic jelly glasses 121 per cent. Sales of pressure and non-pressure ware were up 57 per cent, liquor ware 55 per cent, narrow neck food containers 36 per cent, medicinal and toilet ware 28 per cent, milk bottles 24 per cent, wide mouth food containers 21 per cent, general purpose ware 19 per cent and pressed food ware 8 per cent. Cumulative figures for the 12 months ending January 31, 1942 reveal that shipments during this period were 34 per cent greater than in the previous comparable months. Domestic fruit jars increased 97 per cent, beer bottles 73 per cent, pressure and non-pressure ware 45 per cent, domestic jelly glasses 41 per cent, general purpose ware 39 per cent, wide mouth food containers 28 per cent, medicinal and toilet ware 31 per cent, narrow-neck food containers 28 per cent, liquor ware 26 per cent, milk bottles 34 per cent, and pressed food ware 20 per cent.

GJI THE GLASS INDUSTRY'S INDEX

Production for the Month of January



Inventories of glass containers were 2 per cent higher at the close of January than they were at last year's corresponding date. Stocks of all types of ware increased with the exception of narrow-neck food containers, pressed food ware, pressure and non-pressure ware, beer bottles, and general purpose ware.

Miscellaneous glass products manufactured during January were valued at $16,000,000 as compared with $11,000,000 in January 1941.

Machine-made tumbler production during January amounted to 5,349,832 dozens, which was 67 per cent greater than in last year's corresponding month. Shipments during January increased 57 per cent over January 1941 to 4,143,388 dozens, bringing the total for the 12 months ending January 31, 1942 up to 52,839,849 dozens or 26 per cent greater than in the previous comparable period. Finished stocks of tumblers at the close of January totalled 8,796,627 dozens which about equalled last year's comparable figure.

CURRENT GLASS CONTAINER STATISTICS

(ALL FIGURES ARE IN GROSS)

Types of Ware	*Production*		*Shipments*		*End of Month Stocks*	
	Jan., 1942	*Jan., 1941*	*Jan., 1942*	*Jan., 1941*	*Jan., 1942*	*Jan., 1941*
Food Containers (Narrow neck, wide mouth, and pressed)	1,581,179	1,100,530	1,506,759	1,190,219	2,432,897	2,098,011
Pressure and Non-Pressure	484,480	350,925	351,573	224,423	704,947	906,565
Beer	574,599	294,579	524,425	140,323	421,799	722,923
Liquor	879,867	612,338	904,960	589,933	1,887,575	1,739,503
Medicine and Toilet Prep.	2,313,273	1,552,316	1,884,257	1,467,174	3,379,220	3,157,417
General Purpose	490,772	342,940	398,519	335,838	528,862	666,738
Milk	273,455	206,654	257,247	207,050	375,577	299,741
Fruit and Jelly	131,151	40,437	28,620	8,909	502,683	482,591
All Other	25,739	15,881	20,458	14,902	45,626	36,009
Total Industry	6,754,515	4,516,600	5,876,818	4,178,771	10,279,186	10,109,498

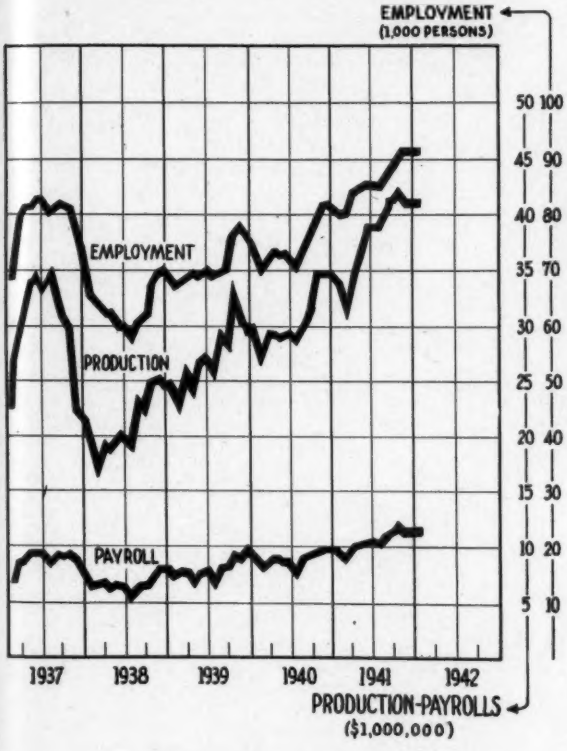
Manufacturers' sales of machine-made table, kitchen and household glassware during January totalled 2,587,410 gross or 12 per cent more than in last year's corresponding months. During the 12 months ending January 31, 1942, 39,357,178 dozens were sold, which represents an increase of 19 per cent over the previous 12 months.

Employment and Payrolls: Employment in the glass industry during January held to the 93,000 persons estimated for the previous 3 months. This compared with 80,300 in January 1941.

Payrolls in the glass industry during January equalled the $12,500,000 reported for November and December. This compares with $9,700,000 in January 1941.

GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through January, 1942



MATHIESON'S NEW PLANT

In accordance with a contract which has been signed by the Defense Plants Corporation and The Mathieson Alkali Works, Inc., work on a new plant for the production of metallic magnesium and chlorine will be begun immediately, according to an announcement made by E. M. Allen, President of the Mathieson Organization.

The plant, which will be located at Lake Charles, La., and will cost approximately $22,500,000, will be owned by the Defense Plants Corporation. It will be operated by Mathieson and will produce about 36,000,000 pounds of magnesium a year by a process developed by Mathieson.

R. M. CURTS TO MANAGER OF BORAX SALES

The American Potash and Chemical Corporation announced on February 1 the appointment of Mr. R. M. Curts as Manager of Borax Sales. In addition to assuming the responsibilities of Manager of Borax Sales, he will continue to handle the sales of bromine, bromides and lithium salts.

Mr. Curts became associated with the American Potash and Chemical Corp. in February, 1931. During the first few years, much of his time was devoted to the technical problems of the sales department, primarily relating to the increasing use of borax and boric acid in the ceramic industry and to the development and sales of new chemicals subsequently manufactured by the Corporation.

M. E. CARLISLE TO PURCHASING AGENT

The appointment of M. E. Carlisle as general purchasing agent of the Pittsburgh Plate Glass Company, succeeding J. A. Bechtel, was announced February 23 by R. L. Clause, president.

Mr. Bechtel is retiring as head of the purchasing department after 50 years of service with Pittsburgh Plate Glass Company organization and will remain with the company during 1942 in an advisory capacity.

Other changes in the purchasing department included the appointment of Homer M. Hoffman as purchasing agent, Glass Division, and E. J. Peters as purchasing agent, Paint Division.

Mr. Carlisle, a native of Braddock, Pa., joined the company in 1929 and has served as an engineer in the glass and paint divisions and as assistant purchasing agent.

B & L EMPLOYEES BUY BONDS

Setting a goal of $500,000 for a one-week campaign of Defense Bond sales, the Balco Defense Bond and Savings Club ran up a total of over a million dollars in subscriptions from Bausch & Lomb employees and affiliated companies.

Under the chairmanship of Hugh T. Walsh, the campaign committee enlisted 100 solicitors, coached and equipped to close subscriptions at bench and lathe, to carry the Defense Bond story to B & L's 8,000 employees.

The Balco Defense Bond and Savings Club is an employee organization, formed to handle all the details of selling and financing bond sales.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

	Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite)		
90%, 99% through 200 mesh....ton	....	....
Precipitated material....ton	55.00	60.00
Barium sulphate, in bags....ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point....ton	15.00–16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)....lb.	....	....
Granulated....In bags, lb.	.0225	.028 –.0305
Powdered....In bags, lb.	.025	.0305–.033
Boric acid (H_3BO_3) granulated....In bags, lb.	.0495	.0555–.058
Calcium phosphate ($Ca_3(PO_4)_2$)....lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)....lb.	.950–.975	.10
Synthetic (Artificial)....lb.	No supplies available.	
Feldspar—(published list prices)		
20 mesh....ton	11.00–13.25	
40 mesh....ton	11.50–13.75	
Granular....ton	11.75–14.00	
Semi-granular....ton	11.00–13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags.		
Fluorspar (CaF_2) domestic, ground, 96–98% (max. SiO_2, 2½%)		
Bulk, carloads, f. o. b. mines....ton	34.00	....
In bags....ton	36.40	50.00
Kryolith (see Cryolite)		
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)....lb.	.0835	....
In 5 Ton lots....lb.	....	.0950
Less than 5 Tons....lb.	....	.10
Lime—		
Hydrated ($Ca(OH)_2$–MgO) (in paper sacks).ton	8.50	8.50
Burnt (CaO–MgO) ground, in bulk....ton	7.50	....
Burnt ground, in paper sacks....ton	9.50	9.50
Burnt, ground, in 280 lb. drums....Per drum	2.35	2.35
Kiln Dried ($CaCO_3$–$MgCO_3$) 10x30 mesh..ton	2.00	....
Kiln Dried ($CaCO_3$–$MgCO_3$) 16x20 mesh..ton	2.00	....
Nepheline Syenite, f. o. b. shipping point....ton	12.50	16.00
Potassium carbonate—		
Calcined (K_2CO_3) 96–98%....lb.	.065	.0675
Hydrated 80–85%....lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4) in bags....ton	21.00–22.00	28.00–30.00
in bulk....	17.50	
Soda ash (Na_2CO_3) dense, 58%—		
Bulk....Flat Per 100 lb.	.95	....
In barrels....Per 100 lb.	1.35	....
In Paper bags....Per 100 lb.	1.10	....
In Burlap bags....Per 100 lb.	1.15	....
Sodium nitrate ($NaNO_3$)—		
Refined (gran.) in bbls....Per 100 lb.	....	3.00–3.40
95% and 97%		
Bulk....Per 100 lb.	1.35	3.60–4.00
200 lb bags....	1.4675	1.48
100 lb bags....	1.475	1.50

Special Materials

	Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)....lb.	.031–.034	.045
Aluminum oxide (Al_2O_3)....lb.	.07	.09
Antimony oxide (Sb_2O_3)....lb.	.15	.15½–16½
Arsenic trioxide (As_2O_3) (dense white) 99%....	....	.04½–.04¾
Barium nitrate ($Ba(NO_3)_2$)....lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)....ton	10.00	13.00
Sodium fluosilicate (Na_2SiF_6)....lb.	....	15.00
Tin Oxide (SnO_2) in bbls....lb.	....	Open price
Titanium Oxide (ceramic grade) (Priority)		
In bags....lb.	....	....
In barrels....lb.	....	....
Zinc Oxide (ZnO)		
American process, bags....lb.	.07¼	.07½
White Seal, 150 lb. bbls....lb.	.09¾	.10
Green Seal bags....lb.	.09	.09¼
Domestic White Seal bags....lb.	.09½	.09¾
Red Seal, bags....lb.	.08½	.08¾
Zircon		
Refined Granular (Milled .01–.02c. higher) .	.06½	.07–.08

Coloring Materials

	Carlots	Less Carlots
Barium selenite ($BaSeO_3$)....lb.	....	1.40–1.60
(Commercial, 25% Selenium)....lb.	....	.85
Cadmium sulphide (CdS)....lb.	....	1.10–1.15
Cerium hydrate—		
100 lb. drums and 600 lb. barrels....lb.	....	.60
Chrome Oxide Green, 400 lb. bbls....lb.	....	.25–.28
Chromite (99% through 200 mesh)....ton	58.25	64.75
Chromite ore (air floated)....ton	58.25	64.75
Cobalt oxide (Co_2O_3)		
In bbls....350 lbs. or more, lb.	....	1.84
Less than 350 lbs., lb.	....	1.94
Copper oxide—		
Red (Cu_2O)....lb.	....	.20–.22
Black (CuO)....lb.	....	.19–.22½
Black prepared....lb.	....	Open price
Iron Oxide—		
Red (Fe_2O_3)....lb.	....	.06–.10
Black (Fe_3O_4)....lb.	.04½	.09
Iron Chromate....lb.	....	.035–.05
Lead Chromate($PbCrO_4$) in bbls....lb.	....	.16
Lithium Carbonate....lb.	....	1.25
Manganese, Black Oxide (Caucasian)		
In Paper bags....ton	70.00	78.00
In Burlap bags....ton	71.75	79.75
In Casks....ton	74.00	82.00
Neodymium oxalate, 50 lb. drums....lb.	....	4.00
Nickel oxide (Ni_2O_3), black....lb.	....	.35–.40
Nickel monoxide (NiO), green....lb.	....	.35–.37
Potassium bichromate ($K_2Cr_2O_7$)—		
Crystals and Granular....lb.	.09½	.09¾–.10
Powdered....lb.	....	.10¼–.10½
Potassium Chromate (K_2CrO_4) 100 lb. kegs...lb.	....	.27
Powder blue....lb.	....	.21–.25
Rare earth hydrate—		
100 lb. drums....lb.	....	.35
325 lb barrels....lb.	....	.30
Selenium (Se) In 100 lb. lots....lb.	....	1.75
In lesser quantities....lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)....lb.	.07¼	.07½–.07¾
Sodium chromate (Na_2CrO_7) Anhydrous....lb.	.08⅛	.08⅞–.09½
Sodium selenite (Na_2SeO_3)....lb.	....	1.50–1.65
Sodium uranate (Na_2UO_4) Orange....lb.	....	1.65
Yellow....lb.	....	1.65
Sulphur (S)—		
Flowers, in bbls....Per 100 lb.	3.40	3.75–4.15
Flowers, in bags....Per 100 lb.	3.05	3.40–3.80
Flour, heavy, in 250 lb. bags....Per 100 lb.	2.95	3.30–3.70
Uranium oxide (UO_2) (black, 96% U_2O_6) 100 lb. lots. Black....lb.	....	2.55
Yellow orange....lb.	....	1.65

Polishing Materials

	Carlots	Less Carlot
Emery, Turkish....lb.	.075	.08
Pumice Stone,		
American Ground FFF, FF, F....lb.	.03	.04
0, 0½, ½, 1....lb.	.05¾	.05¾
Putty Powder....lb.	Open price.	
Rotten Stone, (Domestic)....lb.	.02¼	.03½
Rouge, Red....lb.	.18	.16
Black....lb.	.15	.18

NEW EQUIPMENT AND SUPPLIES

MAGNI-FOCUSER EYESHADE

A new eyeshade, the Magni-Focuser, has been placed on the market by Edroy Products, New York City, and is adaptable to all trades. This eyeshade is equipped with a pair of stereoscopic five power magnifying lenses, which by a slight tilt of the head the subject is brought into focus greatly magnified. The wearer when not using the lenses can readily look beneath the shade with his normal vision. It also affords the use of both hands instead of using one hand as with the old fashioned magnifying glass. The eye-shade is made of plastic, affording protection to the eyes of the wearer from flying parts of steel or shavings.

COOLANT PUMPS

The Eastern Engineering Co., New Haven, Conn., has announced the addition of a complete new series of coolant pumps to its present line, designated Model 17, long and short. It is designed for use on lathes, shapers, milling, drilling, and grinding machines, where a steady stream of coolant or cutting oil is necessary. Also suitable for circulating non-viscous liquids for cooling and circulating applications.

Two heights are available, 19¾" high and 16¾" high. These centrifugal pumps are constructed of cast iron and so designed that there is no metal to metal contact below the liquid level, thus making possible continuous and dependable handling of non-lubricating liquids. The pump inlet, located above the impeller, is tapped for 1¼" standard pipe. The outlet is tapped for ½" standard pipe. The pump is sealed to the motor base, thus eliminating the possibility of any air being drawn into the liquid. A maximum pressure of 6 lbs. per square inch, and a maximum capacity of 17 gallons is claimed with a ⅛ h.p., 1725 RPM, impulsion induction motor.

The main features claimed for the pumps are as follows: Open impeller which allows small chips or grit to pass through the pump without harming or affecting it in any way; no stuffing box to leak, consume power or require adjustment; compact design enables installation in small space; requires no priming. The pumps can be furnished in three different types of mountings—flange, bracket, and sump.

LIQUID COATING FOR GLASS

The Roxalin Flexible Finishes, Inc., Elizabeth, N. J., are manufacturing a liquid glass protector that is said to prevent broken glass from flying. Roxaneal, as the protector is called, is available in clear, transparent form which does not obstruct vision or light. It is also available in blackout type. It may be applied by brushing the material on the interior of clean glass. Windows may then be cleaned, when necessary, with mild soap solutions without affecting the strength of the protective film. Roxaneal is easily removed either by peeling it off with a razor blade, or by washing it off with solvents.

SINGLE FILTER RESPIRATOR

The Mine Safety Appliances Co., Pittsburgh, Pa., have announced a new and improved M.S.A. single filter Dustfoe respirator. The featured improvement of the Dustfoe is the new single filter which replaces the two-part (felt screen and cellulose) filters used previously. The manufacturer states that this one piece filter gives U. S. Bureau of Mines approved protection against an even broader range of dusts and mists. The filter is more porous on the outer side so that the larger dust particles are filtered out first, thus preventing rapid build-up of breathing resistance through clogging of the filter.

LUMINOUS PAINT

A luminous "blackout" paint, which can be applied to objects of all kinds and renders them visible in the dark, has been developed by Maas & Waldstein Company, Newark, N. J. Unlike the radio-active finishes commonly used on watch dials, the new paint owes its luminosity to a substance which re-radiates light, according to the manufacturer. It contains no toxic materials. After the paint has been exposed to either daylight or ordinary electric illumination for a few minutes, it glows for about 20 hours and repeats the action after re-exposure.

The new paint, which is known as Durad Luminous Paint, must be used over a special primer and thinned out with a special thinner, both of which are supplied with the paint. One thick coat, or, preferably, several thin coats, of the paint produces a flat white finish suitable for indoor service. For a glossy finish, or for outdoor service, the paint is covered with a special clear topcoat. Each coat air dries in from 1 to 4 hours depending upon weather and other conditions.

REMOTE VALVE CONTROL UNIT

A newly designed unit for the manual control of remote valves, dampers and other pneumatically operated equipment is announced by The Foxboro Company, Foxboro, Mass. In appearance, the unit harmonizes with the rectangular case in which Foxboro recording and controlling instruments are now available. When the Unit is flush-mounted, its front surface is only 7/16" from the surface of the instrument panel, and as its setting knob and pressure indicator are recessed, there are no protruding parts to suffer accidental bumps.

Specifically designed for dead-end service, the Remote Valve Control Unit will hold reduced pressures, dependably, to values within very narrow limits. Although most commonly used as its name suggests, it is equally useful in other applications, such as setting of the control points of distant instruments or the adjustment of positioning or pressure-producing pistons, located in inaccessible points. It is practical for operation over distances as great as 1000 feet.

CATALOGS RECEIVED

Cleveland Crane and Engineering Co., Wickliffe, Ohio. Booklet No. 2008-A on "Cleveland Tramrail Engineering and Application Data," and covers much of the large subject of overhead materials handling.

Reeves Pulley Co., Columbus, Ind. A 16-page booklet, "More Output for Defense," No. G-423. This booklet illustrates and describes numerous uses and applications for Reeves variable speed control equipment in defense industries and plants on many different types of machines.

Lynch Corporation, Anderson, Ind. Bulletin No. 19-A on the new Lynch "10," 6-mold forming machine for glass containers from ½ ounce to 64 ounce capacity. The Model "10" machine is pneumatically driven, intermittently rotated.

Johns-Manville, New York City. The 1942 edition of the Johns-Manville Industrial Products Catalog, Form GI-6A. This 52-page, illustrated book contains information and recommendations on high and low temperature insulations for industrial needs from 400°F. below zero to 2500°F. above.

General Box Co., Chicago, Ill. The new 12-page booklet, General Box, tells how manufacturers of various types of products are solving their shipping problems and information which should prove important to many shippers.

B. F. Goodrich Co., Akron, Ohio. A booklet just published provides new data on obtaining maximum service from truck tires. Called the Operator's Handbook, the booklet is timely because of the Government's war-program of rubber conservation.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

FLUXTITE by LACLEDE-CHRISTY

. . . the tank block of accurate structure balance made by ceramic experts from a precision blend of fire clays, including the famous Missouri Washed Pot Clays.

Fluxtite and its companion products, Laclede's Super Refractory Mix 89 and Laclede's Refractory Upperstructure, have been and are now meeting the strict requirements of the producers of soda-lime, boro-silicate and all other glasses.

Laclede-Christy, "The Glass Industry Specialists," have everything in refractories for the glasshouse. Consult with . . .

LACLEDE-CHRISTY

The World's Largest Producers of Glass House Refractories

ST. LOUIS . . TOLEDO

GLASS SLICING MACHINES

• We manufacture a variety of wet glass slicing machines for solid glass bars, glass tubing, etc. We can also supply a full line of special glass working machinery for the production of television tubes, fluorescent tubes, incandescent lamps, glass ampules and vials. Glass working lathes and laboratory equipment of all kinds. Cross Fires and Torches. Ask for our catalogue.

•

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CHAS. EISLER, Pres.
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Originators of Alloys for Glass Moulds

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THE SHARP-SCHURTZ COMPANY

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Transparent Colored Blown Sheet Glass
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"TWIN-RAY"—the scientific illuminating glass.

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CONVEX GLASS CO.
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"IF IT'S MADE OF GLASS, ASK US FIRST"

THE OTTAWA SILICA COMPANY

OTTAWA. ILLINOIS

THREE PLANTS TO SERVE YOU

OPERATING YEAR AROUND

CERAMIC CAMERA CLUB

The Fourth Annual Salon of the Ceramic Camera Club will be held April 19 to 25 in the Netherland Plaza Hotel, Cincinnati, Ohio, at the Forty-Fourth Annual Meeting of the American Ceramic Society.

This year the Board of Directors of the Camera Club are allowing six prints to be exhibited by any one exhibitor, providing, however, that these prints are up to the standards set up by that committee. The judges of the salon will be Dr. Glenn Adams, president of the Cincinnati Camera Club, as Chairman; Mr. Frederick Knoop, Cincinnati Camera Club; and Mr. Arnold Henn, Eastman Kodak Company, Cincinnati.

The Frazier Award Committee will be headed by Dr. George W. Morey, Washington, D. C.; Dr. Frank W. Preston, Butler, Pa.; and Miss Alice A. Ayers, Cleveland Heights, Ohio.

Classifications for exhibition judging purposes will be the same this year as last year; namely, portrait, industrial, trade paper, scientific, action, color, pictorial.

No entry fee is required, but entry form, not pictures, must be mailed to Mr. R. W. Knauft, Secretary-Treasurer, c/o Chas. Taylor Sons Co., Box No. 58, Annex Station, Cincinnati, Ohio, and must be received prior to the closing date April 12, 1942.

Each picture must bear on the back, plainly printed its number and title, the name of the photographer, his return address and all such information as given on the entry form. Each picture must bear title names on left bottom corner below print on mount and maker's name on right bottom corner below print on mount.

White or light colored mounts should be used. These must be of standard size 16 in. x 20 in. All prints may be mounted vertically or horizontally.

The deadline for receiving entries for this exhibit has been set for Sunday, April 12. Entries must be sent *parcel post*, marked "Photographs-No Commercial Value. For Exhibition Only. To Be Returned to Sender." Mail prints only to Ceramic Camera Club (Ceramic Exhibit), Netherland Plaza Hotel, Cincinnati, Ohio.

The Ceramic Camera Club is a non-profit organization, intended to develop scientific, pictorial, and industrial photographs throughout the membership of the American Ceramic Society. All persona in the American Ceramic Society who are interested in photography are asked to affiliate with the Ceramic Camera Club. The dues are $3.00 a year. Information regarding the Ceramic Camera Club may be obtained from the secretary.

For All Types of Glassware Moulds & Grey Iron Castings

OVERMYER MOULD COMPANY

Winchester, Indiana

For All Types of Glassware Moulds

OVERMYER MOULD CO. of PENNA.

Greensburg, Penna.

For Screw Products

OMCO PRODUCTS CORPORATION

Springfield, Ohio

MAIN OFFICE . . . . WINCHESTER, INDIANA

Our Blast Furnaces and 7 plants work night and day for Victory.

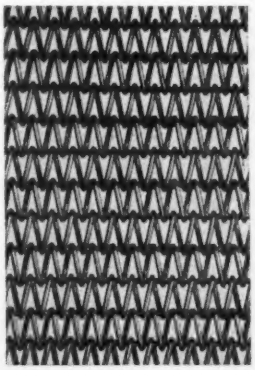
Behind This Scene are Wissco Conveyor Belts

Although we do not build the actual bombers, ships and guns, Wissco Conveyor Belts help make possible mass-production of many of the parts that go into them.

Nuts, bolts and springs for the airplane engines are heat-treated on Wissco Belts. Machine gun cartridge cases are annealed on Wissco Belts.

These tough steel conveyors of mass-produced parts are used for food, glassware, ceramics, metals, textiles and many other military necessities. Each Wissco Belt is custom-engineered to fit temperature and production requirements of the specific work to be done.

Send for our free data book and catalog, "Wissco Conveyor Belts." Write Wickwire Spencer Steel Company, 500 Fifth Avenue, New York. (Also Buffalo, Chicago, Worcester, and San Francisco).



WISSCO PRODUCTS

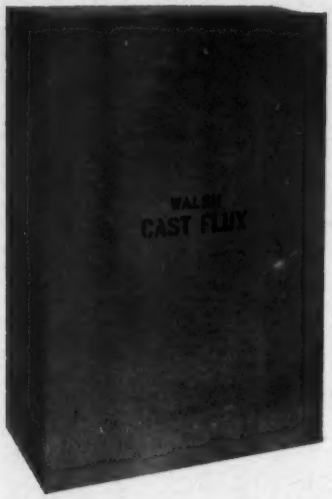
SEND YOUR BELT QUESTIONS TO WICKWIRE SPENCER

WISSCO CONVEYOR BELTS

A Belt for Every Purpose

WICKWIRE SPENCER STEEL COMPANY

WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

Walsh Cast-Flux blocks are machine-trued to exact size and shape after burning.

THEY LAST LONGER

The excellent results obtained in numerous tanks melting various types of glass has definitely established the efficiency and economy of Walsh Cast-Flux blocks.

Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

WALSH REFRACTORIES CORPORATION

Manufacturers of Refractories for the glass industry for over 50 years

4428 North First Street
St. Louis Missouri

THE FTC-ELASTI-GLASS HEARING

(*Continued from page* 94)

products made of such a substance, but rather that Vinylite is not a glass.

The respondent states, on the other hand, that Elasti-Glass is an organic glass and is differentiated from inorganic glass by its elasticity, the term being used in the popular sense for resiliency, a property that inorganic glass does not have. In the true meaning of the term, however, glass is one of the most highly elastic materials.

The outcome of this case is expected to have a far-reaching effect upon the glass manufacturing industry, deciding once and for all whether plastics can be considered glass or not.

THE GLASS INDUSTRY has been informed that complaints have been issued against Saks and Co., Hickock, Pioneer and A. Stein & Co., charging misuse of term glass.

THE A.C.S. PROGRAM

(*Continued from page* 100)

necessary to continue the observations over much longer periods. Making these observations visually is very tiring and even impossible if a test requires several days. For this reason some investigators have used a photographic method. Essentially this method is not unlike that of obtaining motion pictures of the moving interference fringes. To record the passage of each fringe, several pictures (usually about twenty) are necessary. Consequently a very long strip of film is required to record a test if the expansion is large. Moreover, the pictures seldom show a fringe at the exact time when it is passing the fiduciary point in the field.

The new photographic method that has been developed produces a continuous record of the fringe movements, and it requires only about 1 percent of the film needed by the motion picture method. The instrument is so designed that the fringes may be viewed at any time without stopping the recording of their movement. This makes it possible to readjust the alignment of furnace and viewing instrument at any time without stopping the recording. The resultant photographic record, which is named an interferograph, is easily interpreted and the data obtained therefrom are equal to, or better than, data obtained visually.

An Investigation of Decay of Vibration Phenomena of Glass Bars. *By Joe G. McCann: Engineering Experiment Station, Ohio State University, Columbus, Ohio.*

The purpose of the investigation was to correlate the decay of vibration of glass bars with their chemical composition. The moduli of decay of four commercial glasses were determined by a photographic method which employed an oscillograph to provide a graphic representation of the ring emitted by the bars when they were set in vibration. By using bars of identical cross section and different lengths, data were obtained showing the relation of modulus of decay to length. The effect of disannealing on the modulus of decay was also investigated.

INVENTIONS AND INVENTORS

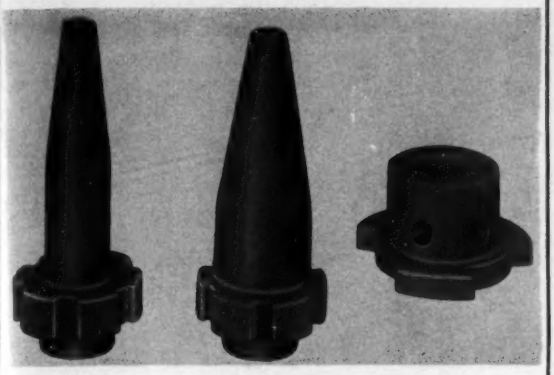
(*Continued from page* 106)

Patent 2,269,231 to Clinton L. Savidge of Toledo, (Ohio Insulation Co.) concerns a nozzle for blowing mineral wool.

Glass Blocks

Erle T. Putnam of Detroit (Libbey-Owens-Ford) received patents 2,270,555 and 2,270,556 for methods and apparatus for making building blocks. In the first of these patents a cement block is cast on top of a glass face plate, while in 2,270,556 the block may be fastened to the face by means of adhesive or by mechanical means.

For Plungers



Gunite Standard grade A

Gunite Foundries Corporation having developed various metals to meet specific glasshouse requirements, recommends for plungers, its Standard grade "A" Castings. Long life, excellent thermo-conductivity and unusual freedom from foundry defects are inherent qualities of Gunite Plungers. May we send you descriptive information on all Gunite glasshouse castings?

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FOUNDRIES CORPORATION
ROCKFORD ILLINOIS

FORTER-TEICHMANN CO.

Engineers and Contractors

for

The Glass Industries

E-X-C-L-U-S-I-V-E-L-Y

119 Federal Street, Pittsburgh, Pa.
Phone FA 1445 **Cable "Forter"**

Aplite

This new material for incorporating ALUMINA in glass at lower cost is providing excellent results.

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Pioneer Producer of APLITE
AlNaK

HOMMEL

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THE O. HOMMEL COMPANY
209 FOURTH AVE. PITTSBURGH, PENNA.
Phone ATlantic 1195

A WAR MESSAGE
to
ALL EMPLOYERS

★ From the United States Treasury Department ★

WINNING THIS WAR is going to take the mightiest effort America has ever made—in men, in materials, and in money! Every dollar, every dime that is not urgently needed for the civilian necessities of food, clothing, and shelter, must, if we are to secure final Victory, be put into the war effort.

An important part of the billions required to produce the planes, tanks, ships, and guns our Army and Navy need must come from the sale of Defense Bonds. Only by regular, week by week, pay-day by pay-day investment of the American people can this be done.

This is the American way to win. This is the way to preserve our democratic way of life.

Facing these facts, your Government needs, urgently, your cooperation with your employees in *immediately* enrolling them in a

PAY-ROLL SAVINGS PLAN

The Pay-Roll Savings Plan is simple and efficient. It provides, simply, for regular purchases by your employees of United States Defense Bonds through systematic—yet voluntary—pay-roll allotments. All you do is hold the total funds collected from these pay-roll allotments in a separate account and deliver a Defense Bond to the employee each time his allotments accumulate to an amount sufficient to purchase a Bond.

The Pay-Roll Savings Plan has the approval of the American Federation of Labor, the Congress for Industrial Organization, and the Railroad Brotherhoods. It is now in effect in several thousand companies varying in number of employees from 3 to over 10,000.

In sending the coupon below, you are under no obligation, other than your own interest in the future of your country, to install the Plan after you have given it your consideration. You will receive—1, a booklet describing how the Plan works; 2, samples of free literature furnished to companies installing the Plan; 3, a sample employee Pay-Roll Savings authorization card; and 4, the name of your State Defense Bond administrator who can supply experienced aid in setting up the Plan.

To get full facts, send the coupon below —today! Or write, Treasury Department, Section B, 709 Twelfth St., NW., Washington, D. C.

HOW THE PAY-ROLL SAVINGS PLAN HELPS YOUR COUNTRY

1. It provides immediate cash now to produce the finest, deadliest fighting equipment an Army and Navy ever needed to win.
2. It gives every American wage earner the opportunity for financial participation in National Defense.
3. By storing up wages, it will reduce the current demand for consumer goods while they are scarce, thus retarding inflation.
4. It reduces the percentage of Defense financing that must be placed with banks, thus putting our emergency financing on a sounder basis.
5. It builds a reserve buying power for the post-war purchase of civilian goods to keep our factories running after the war.
6. It helps your employees provide for their future.

MAIL THIS COUPON NOW

Treasury Department, Section B
709–12th St., NW.
Washington, D. C.

We want to do our part. Please rush full information regarding the Pay-Roll Savings Plan.

NAME.....
POSITION.....
COMPANY NAME.....
ADDRESS.....
NUMBER OF EMPLOYEES.....

MAKE EVERY PAY-DAY . . . BOND DAY!
U. S. Defense BONDS ★ STAMPS